Gibson’s wandering albatross: drone-based population estimate, demography and at-sea distribution

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Report to Department of Conservation, Conservation Services Programme

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Cover photo by Kath Walker:
Courting Gibson's wandering albatrosses in Fly Basin on the southern slopes of Adams Island

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SUMMARY

Gibson's wandering albatross (*Diomedea antipodensis gibsoni*) have been in decline since 2005. Research into the causes of and solutions to the falling numbers of Gibson's albatross includes an annual visit to the main breeding grounds on Adams Island and this report describes the results of the 2025 breeding season. Breeding success in 2024 was 46%, the lowest for 8 years, with only 37 chicks produced from the study colony. The number of pairs nesting in three representative census blocks in 2025 was close to the average of the last ten years, with the poor breeding season in 2024 probably a "blip" rather than the start of a steep decline. Survival of both males and females has improved though confidence intervals around the most recent estimates are so large the level of improvement is not yet clear.

Satellite transmitters taped to the back feathers of 29 adult Gibson's wandering albatross in January 2022 remained attached for an average of 179 days and those attached in January 2024 to 20 adults for 251 days, providing detailed information on patterns of use of the Tasman Sea. A combined total 10,204 days of tracking was recorded from even numbers of adult males and females, 19 of which were not-breeding and 30 of which were. One breeding female was almost certainly caught in June 2024 in the mid Tasman Sea by a longliner flagged to Chinese Taipei. Given the limited number of birds with transmitters and days tracked, this capture suggests an annual mortality rate of adults in fisheries interactions of 3.5% in the two years. Sixteen Gibson's wandering albatross chicks about to fledge from Adams Island were fitted with satellite transmitters in late December 2024 and their movements will be followed throughout 2025.

In January 2024 and January 2025 aerial photographs were taken using drones of the entire breeding grounds of Gibson's albatross on Adams Island. All 4,000ha of albatross nesting habitat was photographed across the two seasons, and 24% was photographed in both years. Orthomosaic images were constructed from the photos and the number of albatrosses on the ground in the orthomosaics were counted. Ground calibration checks undertaken at the same time as the photographs were used to provide correction factors of the proportion of birds on the ground which had eggs (has-egg rate; mean was 54% in 2024 and 67% in 2025). Another correction was made for the likely proportion of eggs not yet laid or nests that had failed at the time the photographs were taken. This lay-fail correction was derived from regular visits to the study area. The two corrections were applied to the number of birds counted from the drone imagery on Adams Island in 2024 and 2025. To estimate each year's whole island number of breeding pairs, a growth-rate estimate from blocks counted both years was applied to blocks only counted in one year. The mean of the two year's estimates was 4,497 breeding pairs. This is the first time since 1997 the number of breeding pairs nesting on Adams Island have been comprehensively assessed across the island. The proportion nesting in annual count blocks in 2024 (9.2%) and 2025 (9.7%) are similar to that recorded in 1997 (10.7%), indicating that the annual count blocks remain representative of whole-island trends in nest numbers. Compared to the ground counts undertaken in 1997, the drone-based estimates provided better coverage as drones could easily go everywhere but nesting birds couldn't be distinguished from other birds on the ground from drone imagery. Therefore, the number of nesting birds is estimated not counted. In contrast, counts undertaken on foot can easily miss birds either obscured by vegetation or in places that are too difficult to walk, but the number of nesting birds is counted not estimated. It is not possible to objectively judge which method is better, but the drone estimates are easier.

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INTRODUCTION

Gibson's wandering albatrosses *Diomedea antipodensis gibsoni* are long-lived, slow-breeding seabirds, vulnerable to bycatch in commercial fisheries. As such, the species is of high conservation concern (Birdlife International 2018; Robertson et al. 2021). Assessments of the risk of commercial fisheries to seabird populations (Edwards et al. 2023) can be profoundly affected by uncertainty in population size and uncertainty in demographic rate estimates, particularly adult survival (Walker et al. 2015). To reduce uncertainty or bias in estimates of risk from fishing, robust information is needed on key aspects of biology (survival, productivity, recruitment, population size and trends). This is the focus of this report.

Gibson's albatrosses are endemic to the Auckland Island group. Most (94%) of the population breed on Adams Island, about 5% on Disappointment Island and a few scattered pairs (1%) on main Auckland Island make up the remainder (Elliott et al. 2020). 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).

Gibson's albatross survival, productivity, recruitment, and population trends have been monitored during annual visits to Adams Island since 1991. In the 1990s, the population slowly increased following a major, presumably fisheries-induced, decline during the 1980s (Walker & Elliott 1999; Elliott et al. 2020). However, between 2004 and 2006 there was a sudden 68% drop in the size of the breeding population, from which recovery has been very slow (Elliott et al. 2020). The Gibson's albatross population is still less than half of its estimated size in 2004, having lost the gains slowly made through the 1990s (Rexer-Huber et al. 2020).

This report summarises work undertaken as part of the Department of Conservation's (DOC) Conservation Services Annual Plan 2022-23 (Department of Conservation 2022) which has the following objectives:

1. To monitor the key demographic parameters of Gibson's albatross to reduce uncertainty or bias in estimates of risk from commercial fishing.
2. To estimate the population size of Gibson's albatross.
3. To describe at-sea distribution of Gibson's albatross

The most recent findings on the survival, productivity, population size and trends and at-sea distribution of Gibson's albatross collected during a ten-week trip to Adams Island from 2 December 2024–7 February 2025 are presented.

METHODS

Mark-recapture study

A 61ha study area on Adams Island (Fig. 1) has been visited repeatedly during each season since 1991 to band nesting birds and collect re-sightings of previously banded birds. The wider areas around the study area (within a kilometre) are visited less frequently and any banded birds are recorded. All birds found nesting within the study area have been double banded with individually numbered metal bands and large numbered coloured plastic bands, and since 1995 most of each year's chicks 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 dependent on the availability of transport. In 27 of the last 35 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 banded. In the other eight years researchers either did not arrive (2021) or arrived late after most chicks had fledged.

Survival rates are estimated from re-sightings of the banded birds using maximum likelihood mark-recapture statistical methods implemented in the software package MARK via the R package RMark (White & Burnham 1999; Laake 2013; R Core Team 2023). A multi-state model is used (Brownie et al. 1993) in which 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 different detection probabilities and survival rates which are estimated by the model. In addition, the model estimates the probabilities of transition between the strata, for example the probability of being a non-breeder one year and then a breeder in the following year. Some transition probabilities in this model are specified rather than estimated. In particular: birds may not change sex; after successful breeding birds invariably become "sabbatical" birds; and they may not transition to "sabbatical" from any stratum other than "successful breeder". Although detection and transition probabilities are estimated for all strata, for estimation of survival, failed and successful breeders are combined into a breeding stratum, and non-breeders and sabbatical birds are combined into a non-breeding stratum. This is done because the more complex model produces survival estimates with very large standard errors.

In this model the notation of R is specified by:
Survival S ~ year * breeding * sex
Detection probability *p* ~ year * stratum * sex
Transition probability *psi* ~ year * stratum * sex
$psi_{\text{(successful breeding to sabbatical)}}=1$
$psi_{\text{(failed breeding to sabbatical)}}=0$
$psi_{\text{(non-breeding to sabbatical)}}=0$
$psi_{\text{(sabbatical to sabbatical)}}=0$

Population size is estimated by dividing the actual counts of birds in each class (except sabbatical birds) by the resighting probability produced when estimating survival. Counts of sabbatical birds are always very low, so the number of sabbatical birds is estimated by multiplying the number of successful breeders in the previous season by their estimated survival. The survival estimates assume no emigration and thus underestimate survival as birds that emigrate are treated as if they died. However, 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 usually detected during the census of surrounding country (Walker & Elliott 2005). In other words, the underestimate is small, unquantified but consistent from year to year.

Nest counts in representative blocks

Since 1998, all the nests in three census areas (Fig. 1) representative of low (Rhys's Ridge), medium (A-A) and high (Fly Square) density have been counted each year, apart from 2021 when the island was not visited. Counts are carried out between 23–31 January just after the completion of laying, and as close as possible to the same date at each place in each year. A transect search method is used where observers walk back and forth across the area to be counted, each within a GPS-defined 25m wide transect. Observers search for albatrosses sitting on nests within the transect. Every bird on a nest is checked for the presence of an egg, and each nest found with an egg is marked with a dot of spray paint, recorded on the GPS, and counted. All birds whether on a nest or just on the ground are also counted. All birds are checked for leg bands, the number and location of which are recorded.

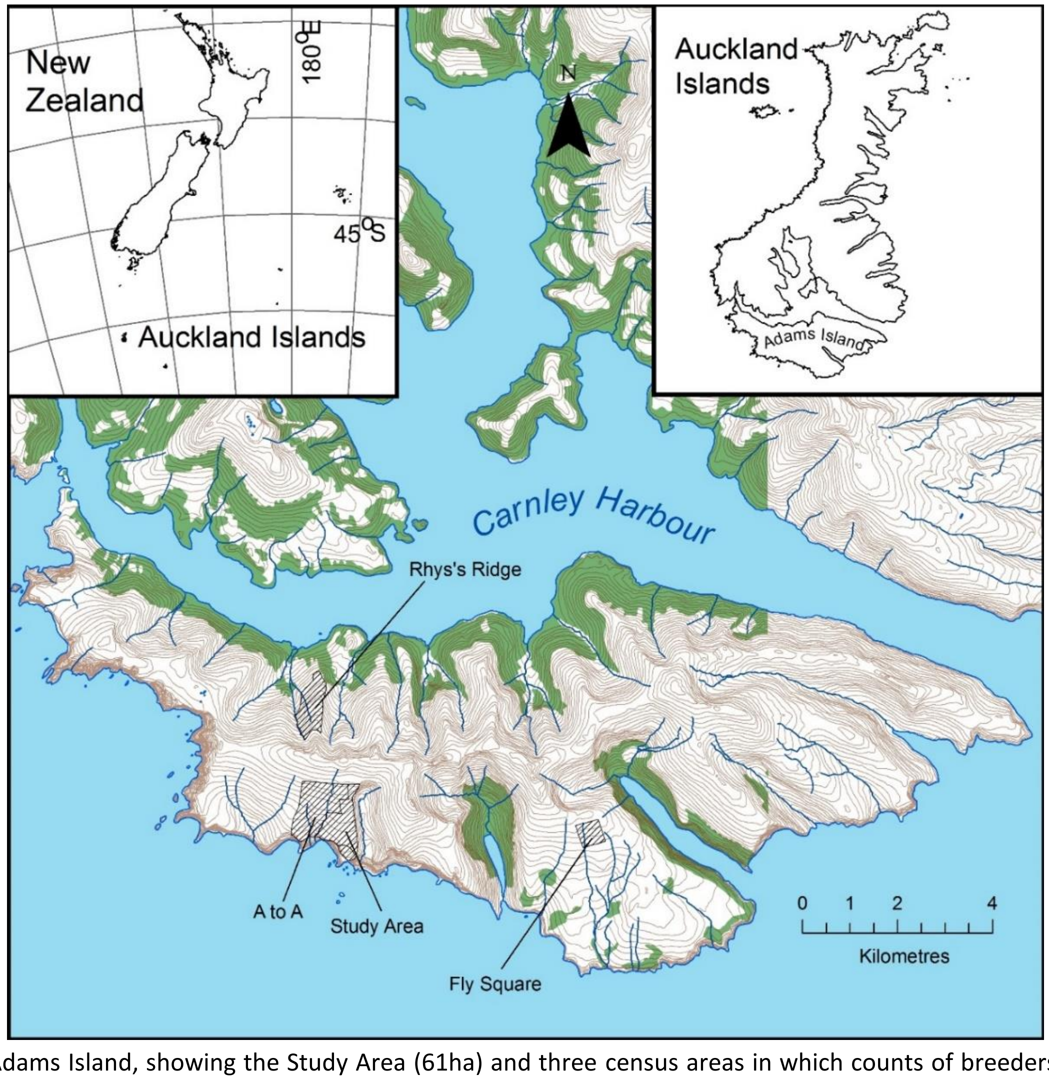

Figure 1: Adams Island, showing the Study Area (61ha) and three census areas in which counts of breeders are made (shaded): Amherst to Astrolabe (A to A; 101ha) Rhys's Ridge (67ha), and Fly Square (25ha).

Once the whole block has been counted, the accuracy of the census is checked by walking straight transects at right angles to the original transects, checking all nests within 10–15m of the transect for paint marks indicating the nest has been counted. Counts are corrected to take account of any eggs not yet laid or any failed nests at the time of counting. The corrections involve estimating the number of eggs yet to be laid and nests that are likely to have failed in each count block by interpolating the proportion of eggs laid and nests failed in the repeatedly monitored study area on the day of the count.

Rhys's Ridge, which is the smallest of the representative count blocks and the most difficult to count accurately due to its deep scrub, was counted in 2023, 2024 and 2025 using aerial photos taken by drone. All counts were corrected for birds on nests without eggs by concurrent ground transects across the upper portion of Rhys's Ridge.

To determine whether the three representative blocks have similar trajectories, or whether they vary independently of each other, the counts from the three blocks between 1998 and 2016 were analysed (Elliott et al. 2016). Similar trajectories would support the notion that a count of a small proportion of the population is likely to be representative of the whole population, while independent trajectories would suggest that a high proportion of the island would have to be counted to be confident of characterising the trajectory of the whole population. The analysis in 2016 concluded the three blocks had the same trajectory. This analysis was repeated in 2025 using more sophisticated statistical techniques and a longer time series. In particular, spline curves were fitted to the relationship between year and the counts, and two competing generalised linear models with negative binomial errors were tested: one with separate intercepts for each block, but the same curve, and another with separate intercepts and curves. Analysis was carried out in R (R Core Team 2023) using the package glmmTMB (Brooks et al. 2017). Model fit was examined using the Dharma package (Hartig 2022).

Estimating total breeding pairs on Adams Island from representative block counts

In 1997 the three census blocks on Adams Island were estimated to hold approximately 10.7% of the nesting pairs on Adams Island, and 10.1% of all nesting pairs (ie the combined total on Adams, Disappointment and Auckland Islands). Note in recent reports, 10.1% rather than 10.7% was erroneously used when estimating the annual number of nesting pairs on Adams Island.

The 2024 and 2025 census of Adams Island nests provided the opportunity to examine and update the percentage of the pairs nesting on Adams Island which are in the three census blocks to 9.2% (2024) or 9.7% (2025). The total number of nests on Adams Island each year in 1997–2025 were retrospectively estimated using the mean of the 2024 and 2025 percentages, 9.5%.

Drone-based estimate of total breeding pairs on Adams Island

Drones were used to fly over and photograph all the albatross nesting habitat on Adams Island. Orthomosaic images were then constructed and all the albatrosses on the orthomosaics were counted. The aerial photography was taken in order to estimate the number of Gibson's albatross incubating an egg in January 2025, so corrections were applied to the orthomosaic counts to account for birds counted in the aerial imagery that were not nesting, and to account for any eggs laid after, or nests failed before the photographs were taken.

Drone techniques suitable for use on Gibson's albatross were developed in the 2022/2023 summer expedition to Adams Island (Walker et al. 2023) and refined during the first few weeks of the 2023/2024 summer expedition. Between 18 January and 25 February 2024, 65% of the albatross habitat on Adams Island was flown, but wet, windy and foggy weather that summer precluded droning the remainder (Elliott et al. 2024). The census was completed approximately a year later between 13 January and 2 February 2025, with the remaining 35% of the albatross habitat flown, and 24% (942ha) flown in 2024 were flown again in 2025.

The technique and drones used in both 2024 and 2025 were the same, as follows. The 3,936 ha on Adams Island in which Gibson's albatrosses had previously been seen to nest (Walker & Elliott 1999) were sub-divided into 276 x 15ha blocks for systematic aerial photography by drone. Four drones were used: 2 DJI Mavic 3E and two Mavic 2 Pro. Flight characteristics for the two types of drone differed because they had different cameras and batteries, but flights were planned in UGCS software (https://www.sphengineering.com/flight-planning/ugcs) to obtain the same output from both types of drone; a ground resolution of 1.5cm per pixel and forward and side overlaps of 65%. The 65% overlap was sufficient to produce orthomosaic images using photogrammetry, and the 1.5cm/pixel resolution was sufficient to confidently identify albatrosses on the ground. The Mavic 3E drones had a longer battery life (45 minutes) and could record images more quickly which meant they could be flown at 15m/s and still be able to store images taken at as little as 0.7 seconds apart. In contrast the Mavic 2 Pro had only 31 minutes of battery life and had to be flown at only 7.5m/s to store images taken no less than 2.5 seconds apart. Flight plans which covered 15ha per battery for the Mavic 2 Pro and 30ha per battery for the Mavic 3E were made. Flights plans were uploaded to the drones and the flying and image capture were automatic. Human intervention was required only for take-off and landing. These set flight parameters flight plans were a compromise: in light winds the drones could have covered much more ground than they were programmed to using these parameters, but in strong winds they would have been unable to complete the planned flights before their batteries went flat.

Images taken by drones were used to construct orthomosaics by photogrammetry using Drone Deploy (https://www.dronedeploy.com/) and webODM (https://www.opendronemap.org/webodm/). Albatrosses on the orthomosaic images were counted using QGIS software (https://qgis.org/en/site/). The orthomosaics were overlaid with a 15x15m grid, and each 15x15m square was zoomed in on so that it filled the computer screen, making all the birds present in each square visible. At this scale (approximately 1:70 depending on screen size) albatrosses were easily recognisable. Because it wasn't possible to reliably distinguish between birds sitting on eggs and birds sitting on empty nests, or sometimes even from standing birds, **all** the birds on the ground were counted, apart from chicks which were readily distinguishable from adults.

Each time a drone flight was undertaken, a ground calibration was required to allow correction for the relative proportions of birds seen on the drone imagery which did, or did not, have an egg, calculated as a 'has-egg' rate. This calibration was achieved in either of two ways:

1. Walking transects

At the same time as the drone was being flown, a walking transect was undertaken over part of the same ground the drone was flying over, or nearby. The transect was undertaken in the same weather and within a few hours of the drone flight. All birds encountered on the transect were recorded and every sitting bird checked to see whether it had an egg. A has-egg rate correction factor for the wider area was subsequently calculated by dividing the number of eggs found on the transect by the number of birds encountered.

2. Re-flying already ground-counted blocks

Either just before or soon after a drone flight, an additional drone flight was made over the geographically closest of either the Study Area or Fly Square, where the number of active nests with eggs was known as it had previously been ground-counted. From the number of albatrosses present in drone imagery, a correction factor was calculated by dividing that droned albatross total by the number of eggs known to be in the block.

Standard errors of the has-egg rate were estimated using two scenarios. In the best case it was assumed that each block flown was perfectly matched in time and space with the has-egg rate estimate, and that the birds counted for estimation of the has-egg rate were a random sample of the birds photographed. In this case the only errors are sampling errors and the binomial standard error for each has-egg rate is appropriate. In the worst case it was assumed that the has-egg rates were not matched with blocks, and the appropriate standard error is the standard error of all the has-egg rate estimates.

In addition, a "lay-fail" correction was made for nests that might have failed before, or for eggs that might be laid after the block was photographed. The lay-fail correction was derived from the closely monitored study area where the total number of eggs laid by the end of the laying season was known, and the number of active nests was checked every few days from the start of laying until the end of the drone-based photography. Separate lay-fail correction curves were generated for 2024 and 2025 by fitting spline curves to the relationship between date using R (R Core Team 2023) and the glmmTMB package (Brooks et al. 2017) which provided estimates of the lay-fail correction for every day of the drone-based photography as well as their standard errors.

The number of nests in each drone-flown block was estimated from:

$$\text{nests} = \text{birds counted} \times \text{has-egg rate} / \text{lay-fail correction}$$

The standard error of the number of nests was estimated using standard errors of the has-egg rate and lay-fail correction and the error propagation rules of Ku (1966) who provides formulae for estimating standard errors of new estimates derived when two or more estimates (with standard errors) are multiplied, divided, added or subtracted. Albatrosses on the photomosaics stand out so clearly the count of their number was assumed to have no error.

As the number of birds nesting varies considerably between years due to the biennial breeding cycle of Gibson's albatross, it was necessary to provide whole island estimates for both 2024 and 2025, despite each year missing (different) portions of the island. To do this, a growth rate (and standard error) was estimated between 2024 and 2025 for those 15ha blocks that were counted in both years, and this rate was applied to those blocks only counted in one year. The relationship and its standard errors was estimated using a negative binomial GLM using R (R Core Team 2023) and the glmmTMB package (Brooks et al. 2017). Ku's (1966) error propagation rules were used to incorporate this source of error into the standard errors of these estimated block counts.

Number of southern royal albatrosses on Adams Island

In the drone-based estimate there was potential for inflating the Gibson's albatross count with southern royal albatrosses (*Diomedea epomophora*) as small numbers of the latter have been recorded at four sites in southeastern Adams Island in the past, Gilroy Head, Bollon's Ridge, Royal Ridge and upper Fly (Basin and Sidle) (Robertson 1975, Buckingham et al. 1991, Miskelly et al. 2020, Elliott et al. 2020). While southern royal albatrosses and Gibson's albatrosses can be readily distinguished on the ground by the presence of a black line along the edge of the bill in royal's, this is not visible from the air. To overcome this, the site southwest of the head of Fly Harbour was comprehensively searched on foot, while ground truthing transects were carried out in association with aerial census on Royal Ridge and Bollon's Ridge. Gilroy Head was the only site not able to be searched on foot in 2025.

Collecting samples from Gibson's albatross

To help determine what the diet of Gibson's albatrosses had been in 2024, feather and bolus samples were collected. Four to six feathers from 35 birds (15 chicks, 10 adult males and 10 adult females) and 15 boluses (small balls of accumulated undigestible material, mostly squid beaks) regurgitated by chicks just before fledging were collected in December 2024. The adult feathers were collected from birds in the albatross study area held for measuring, and those from juveniles were collected from chicks about to fledge from the boundary between the A-A census block and Astrolabe Basin. All samples and data derived from it will be stored and managed according to protocols agreed between the Department of Conservation and Te Rūnanga o Ngāi Tahu.

Flying characteristics of Gibson's albatross

Proposals to construct offshore windfarms in New Zealand and Australian waters mean there is a need to collect information about possible interactions between seabirds and wind turbines. On 3rd and 8th January 2025, 12 IGOTU loggers were taped to the back feathers and twelve geolocator dataloggers (GLS) were cable-tied to the leg bands of seven male and five female Gibson's albatrosses nesting in the study area. Nine small IGOTU loggers recorded GPS fixes at 15-minute intervals and three large IGOTU loggers recorded GPS fixes at five-minute intervals. The GLS recorded the amount of time the birds spent on the water by sampling conductivity every six seconds. The aim was to retrieve this equipment after each bird had made a single foraging flight. The results of this study will be analysed and reported separately.

At-sea distribution

The length of tag attachment and at sea distribution of 29 adult Gibson's albatrosses (15 female, 14 male) wearing taped on satellite transmitters (Telonics TAV2630) in 2022 (Parker et al. 2022), and of 20 more (10 female, 10 male) in 2024 (Elliott et al. 2024) were recorded. Possible interactions with fishing vessels by these birds were detected by comparing the birds' tracks with contemporary locations of longline fishing vessels based on Automated Identification System (AIS) data, available from https://globalfishingwatch.org/map/, the Global Fishing Watch website.

On 10th and 16th December 2024, a further 16 satellite tags were attached to juvenile albatrosses just before they fledged (Table 1). Eight of the transmitters were very light (25g) Druid Technologies Yawl C2 transmitters which collect GPS location data with on average 66 fixes per day throughout the day. Eight were still reasonably light (35g) Telonics TAV 2360 transmitters which collect Argos locations with on average 6 locations per day between 9 and 10:30am and 11 pm and midnight (NZ summertime).

Both transmit locations to Argos satellites. Four Druid tags were put on chicks who were presumed (on bill tip width) to be males and four on chicks presumed to be females. The eight TAV tags were likewise split 50:50 between presumed male and presumed female chicks.

As the battery powered TAVs were programmed with a conservative duty cycle and the Druid tags are solar powered, they could potentially transmit for up to 15 months until the back feathers to which they are taped are moulted. However, mortality soon after fledging is expected to be higher than at other times of an albatross's life and four of the transmitters failed 1 –3 months post fledging (Table 1). Analysis of the juvenile tracks will be undertaken in 2026 after the transmitters cease to provide information.

Table 1: Satellite transmitters attached to 8 male and 8 female juvenile Gibson's wandering albatross in December 2024.

name	Sex	Transmitter type	Deployed	Stopped transmitting
Black-50k	Female	Druid, Yawl C2	15/12/2024	
Black-51k	Male	Druid, Yawl C2	16/12/2024	
Black-58k	Female	Druid, Yawl C2	10/12/2024	
Black-69k	Male	Druid, Yawl C2	10/12/2024	
Black-80k	Male	Druid, Yawl C2	10/12/2024	
Black-83k	Female	Druid, Yawl C2	10/12/2024	6/02/2025
Black-84k	Female	Druid, Yawl C2	16/12/2024	
Black-85k	Male	Druid, Yawl C2	16/12/2024	17/03/2025
Black-63k	Male	Telonics, TAV2360	13/12/2024	14/05/2025
Black-71k	Female	Telonics, TAV2360	13/12/2024	
Black-73k	Female	Telonics, TAV2360	10/12/2024	10/04/2025
Black-76k	Female	Telonics, TAV2360	13/12/2024	
Black-78k	Male	Telonics, TAV2360	10/12/2024	
Black-79k	Male	Telonics, TAV2360	10/12/2024	
Black-86k	Male	Telonics, TAV2360	10/12/2024	27/04/2025
Black-88k	Female	Telonics, TAV2360	13/12/2024	24/02/2025

RESULTS

Population size estimate from mark-recapture

The size of the breeding population in the study area estimated by mark-recapture was increasing up until 2004, but between 2005 and 2008 fell precipitously, particularly the number of females. Between 2008 and 2014 females appeared to increase slightly in abundance while males remained stable. Since 2017, the slow improvement in numbers of both sexes seems to have reversed. However, interpretation of the last few years data is hampered by a missed visit to the island in 2021 and large confidence intervals around the most recent estimates (Fig. 2).

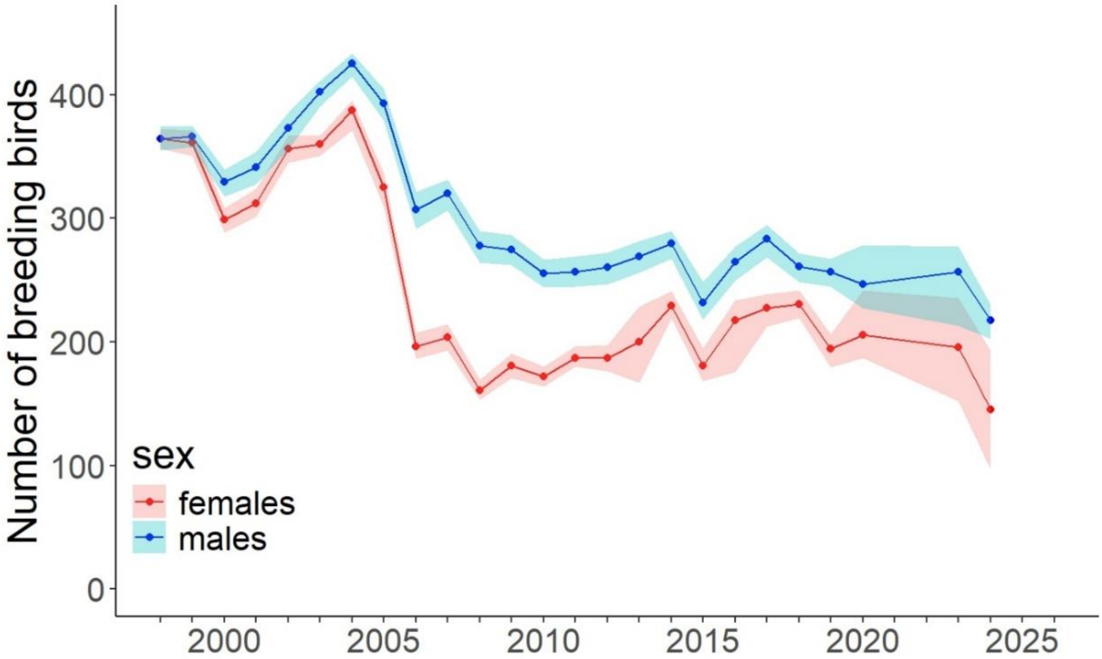

Figure 2. The number of breeding Gibson's albatrosses in the Adams Island study area between 1998 and 2024 estimated by mark-recapture. Shaded areas are 95% confidence intervals.

Survivorship

Adult survival varied around a mean of about 96% up until 2004 and during this period male and female survival were similar (Fig. 3). Survival dropped substantially after 2005, with female survival reaching catastrophically low levels in 2005 and 2007. Female survivorship has improved considerably since 2018, but as the last few estimates have very large confidence intervals, they are unreliable and need to be treated with caution (Fig. 3).

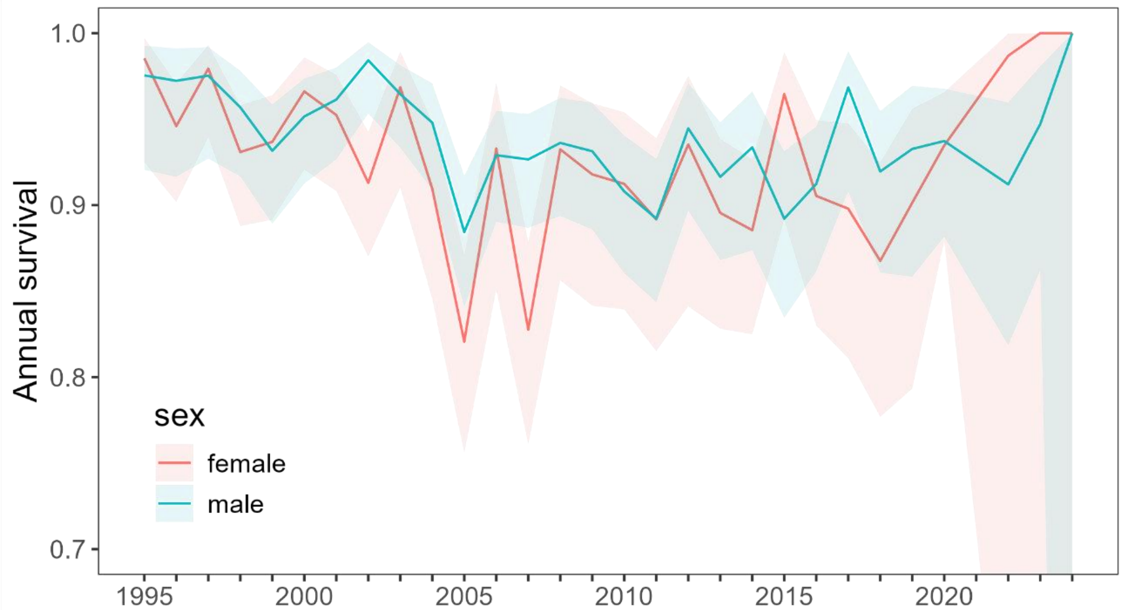

Figure 3. Annual survival of Gibson's albatross in the Adams Island study area since 1995, estimated by mark-recapture. Shaded areas are 95% confidence intervals.

Productivity

Breeding success was estimated at 46% in 2024 (Fig. 4, blue line), the lowest for 8 years. The low breeding success and low number of birds nesting in 2024 meant that the number of chicks produced in the study area (37) was also very low (Fig. 4, red line). The last two years drops in breeding success and chick production need to be taken in the context of an overall trend of improving breeding success and chick production since the crash of 2005, though the extent of the most recent drops is notably greater than other interannual decreases over that period.

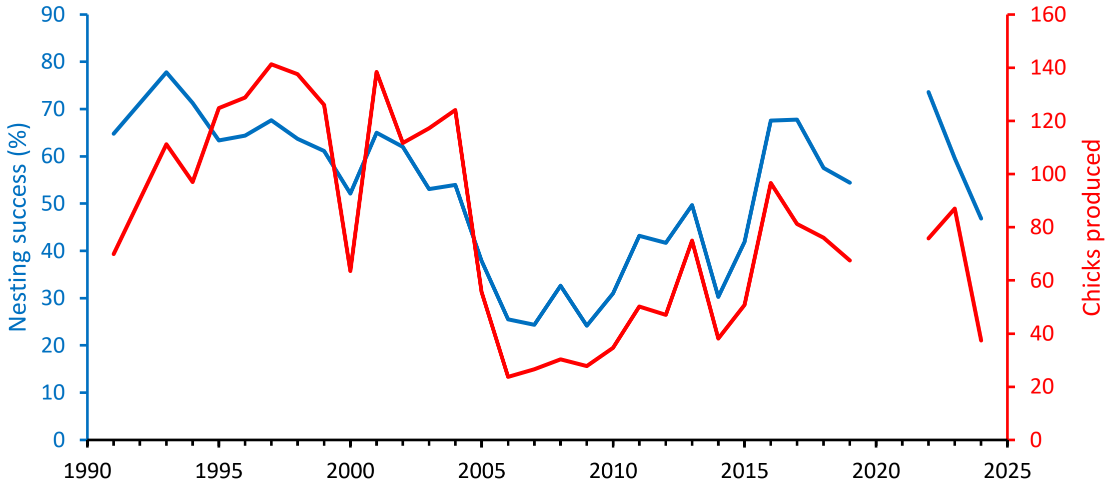

Figure 4. Gibson's albatross nesting success and the number of chicks fledged from the study area on Adams Island since 1991.

Number of pairs nesting in representative blocks

The number of pairs nesting in the three representative census blocks in 2025 was 30% higher than in 2024 and similar to the average count over the last 10 years (Fig. 5), suggesting the low count of 2024 was probably a "blip" rather than the first drop in a steep decline.

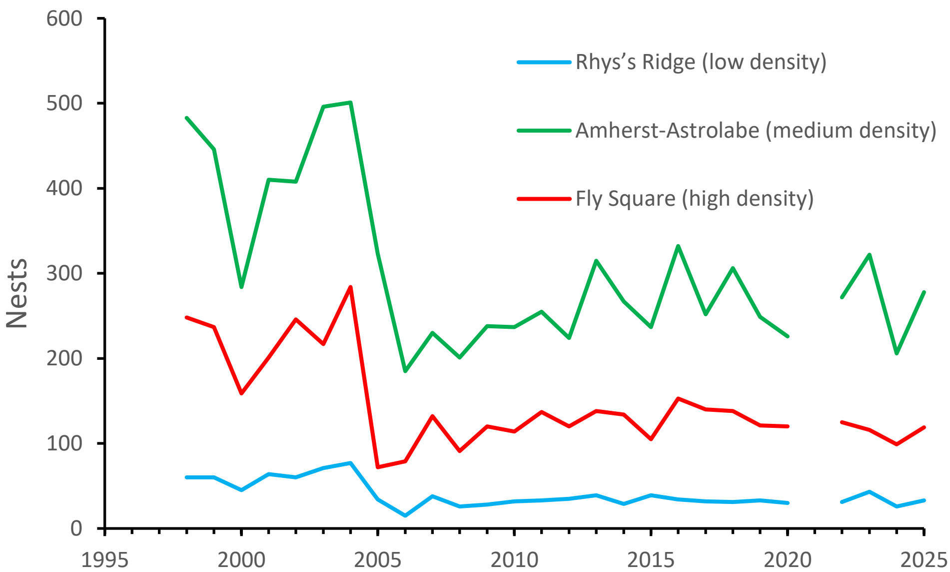

Figure 5. The number of Gibson's albatross nests in three census blocks on Adams Island 1998–2025.

When multiplied up by the proportion of the total population present in the three census blocks calculated in 2024 (9.2%) and 2025 (9.7%), and when corrections were made for eggs not laid at the time of counting and nests already failed, the estimated total number of nests on Adams Island in 2024 and 2025 was 4,130 and 4,865 nests respectively (Table 2).

Table 2. Gibson's albatross nests with eggs in late January in three census blocks on Adams Island, 1997–2025. Corrected total is the estimated number of nests in the three blocks taking account of the number of failed nests and unlaid eggs at the time of counting (the correction factor applied each year is the ratio between the 5th and 6th columns). Estimated Adams Island Total is the estimated number of nests on the whole of Adams Island based on the mean (9.5%, comprising 0.8% on Rhys's Ridge, 5.9% Amherst to Astrolabe, 2.7% in Fly Square) of the proportion nesting in the three counted blocks in 2024 (9.2%) and 2025 (9.7%). *= drone-based estimate.

Year	Rhys's Ridge (low density)	Amherst-Astrolabe (medium density)	Fly Square (high density)	Total no. of nests counted	Total corrected for unlaid eggs and failed nests	Estimated Adams Island Total
1997					796	8414
1998	60	483	248	791	798	8436
1999	60	446	237	743	746	7886
2000	45	284	159	488	497	5254
2001	64	410	201	675	706	7463
2002	60	408	246	714	740	7822
2003	71	496	217	784	791	8362
2004	77	501	284	862	884	9345
2005	34	323	72	429	452	4778
2006	15	185	79	279	341	3605
2007	38	230	132	400	430	4545
2008	26	201	91	318	341	3605
2009	28	238	120	386	426	4503
2010	32	237	114	383	392	4144
2011	33	255	137	425	438	4630
2012	35	224	120	379	418	4419
2013	39	315	138	492	519	5486
2014	29	267	134	430	473	5000
2015	39	237	105	381	406	4292
2016	34	332	153	519	545	5761
2017	32	252	140	424	448	4736
2018	31	306	138	475	489	5169
2019	33	249	121	403	423	4471
2020	30	226	120	376	391	4133
2021	No count					
2022	31	272	125	428	449	4746
2023	43	322	116	481	501	5296
2024	26	206	99	331	380	4130*
2025	33	278	119	430	472	4865*

The 2024 and 2025 estimates of the number of nesting pairs on Adams Island are drone-based and an average of 520 pairs higher than would have been estimated when based on the 1997 whole island ground census and subsequent annual counts of three blocks.

To determine whether the three count blocks had similar trajectories, or whether they varied independently of each other, a suite of generalised linear models of the relationship between date and the number of nests counted in the three counted blocks were examined. A spline curve with five knots best fitted the data, and a model with a common spline curve for all three blocks fitted the data substantially better than did a model with separate curves for the three blocks (Table 3). This suggests the three blocks have the same trajectory and the differences between them are attributable to noise.

Table 3. Model selection table for the relationship between date and nest counts in 3 blocks.

	K	AICc	ΔAICc	AICcWt
1 spline curve with 5 knots	9	764.12	0.00	0.73
1 spline curve with 6 knots	10	766.24	2.11	0.25
1 spline curve with 7 knots	11	771.73	7.61	0.02
1 spline curve with 4 knots	8	780.80	16.67	0.00
1 spline curve with 3 knots	7	782.84	18.72	0.00
1 spline curve with 2 knots	6	784.20	20.08	0.00
3 spline curves with 5 knots	19	791.71	27.58	0.00
3 spline curves with 6 knots	22	801.65	37.53	0.00
3 spline curves with 7 knots	25	815.72	51.60	0.00

Drone-based estimate of nesting Gibson's albatross on Adams Island

The aerial census of Gibson's albatross was completed over two summers: between 18 January and 25 February 2024 (Elliott et al. 2024) and between 13 January and 2 February 2025. Of the 3,936ha of albatross nesting habitat on Adams Island, 1,623ha (41%) was counted only once in 2024, 1,371ha (35%) was counted once in 2025 and 942ha (24%) was counted in both years (Fig. 6).

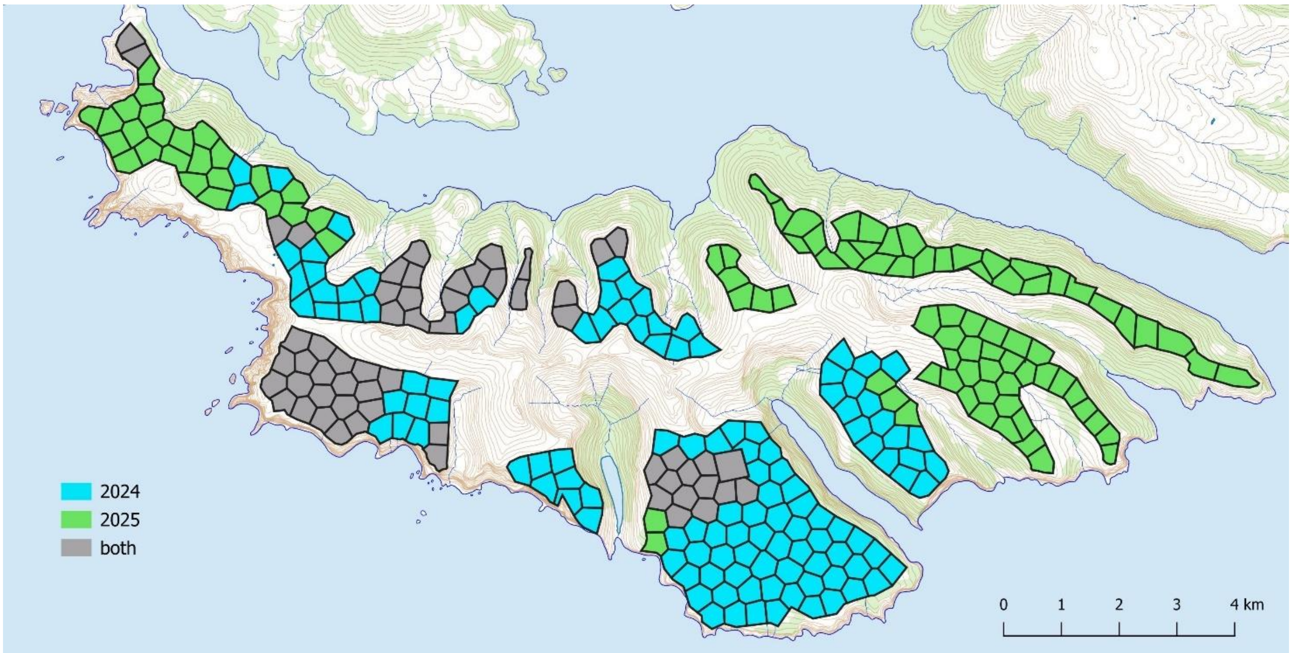

Figure 6. The 3,936ha of Gibson's albatross nesting habitat (coloured areas within black borders) on Adams Island over which drones were flown in 2024 (red) and 2025 (green) and in both years (grey).

Ground-truthing, either by transect counts or by re-flying of already ground-counted blocks, showed considerable variation in the ratio of birds on the ground incubating an egg to all birds on the ground, the 'has-egg' rate, ranging from 0.36 to 0.90 (Table 4). The has-egg rate varied not just with area but with time of day, with the counts undertaken in the morning generally having fewer non-nesting birds. On average 67% of birds on the ground in 2025 had a nest with an egg (has-egg rate) compared to 54% in the poor 2024 breeding season, with the rest being birds either sitting or standing without an egg.

Table 4. Breeding status of birds encountered along transects or in drone photos of already ground-counted blocks, and the resultant has-egg ratio (birds on egg/total birds on ground) used to correct counts made from drone flights.

Date time	Place	Method	Birds on eggs	Birds without eggs	Total birds on ground	Has-egg ratio
26/01/2025 12:50	Fly Square	drone	127	67	194	0.65
26/01/2025 15:14	Fly Square	drone	127	71	198	0.64
02/02/2025 09:10	Study Area	drone	66	11	77	0.86
24/01/2025 9:45	Study Area	drone	19	2	21	0.90
24/01/2025 10:45	Study Area	drone	10	9	19	0.53
24/01/2025 11:45	Study Area	drone	16	3	19	0.84
24/01/2025 09:45	Study Area	drone	45	14	59	0.76
21/01/2025 16:22	Maclaren Ridge	transect	5	3	8	0.63
17/01/2025 13:03	Magnetic and Rhys's Ridges	transect	24	12	36	0.67
23/01/2025 12:10	Astrolabe to Amherst	drone	17	8	25	0.68
23/01/2025 13:40	Astrolabe to Amherst	drone	78	21	99	0.79
23/01/2025 17:00	Astrolabe to Amherst	drone	37	19	56	0.66
15/01/2025 09:00	Fairchild's to Fall Bay	transect	12	11	23	0.52
15/01/2025 12:00	Fairchild's to Fall Bay	transect	21	12	33	0.64
15/01/2025 14:30	Fairchild's to Fall Bay	transect	12	18	30	0.40
13/01/2025 11:00	Bollon's Ridge	transect	29	9	38	0.76
13/01/2025 13:00	Lower Gilroy Ridge	transect	28	36	64	0.44
13/01/2025 15:00	Royal Ridge	transect	9	16	25	0.36
14/01/2025 10:32	Upper Gilroy Ridge	transect	18	10	28	0.64
Total			**700**	**352**	**1052**	**0.67**

Data from regular visits to the study area produced correction factor curves to account for failed nests and yet-to-be-laid eggs (Fig. 7).

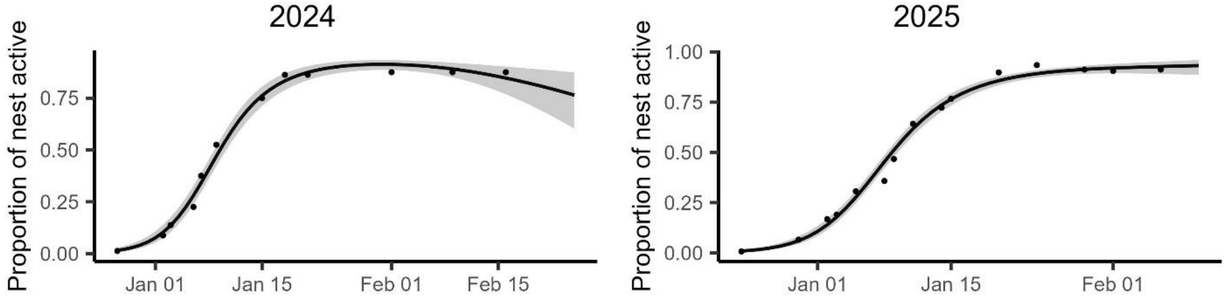

Figure 7. Fitted curves of the relationship between date and the proportion of nests that have eggs in the study area in 2024 and 2025. Grey shaded areas are 95% confidence intervals.

Fifty-four 15ha blocks were counted by drone in both 2024 and 2025, and the relationship between the number of nests in each of these blocks in the two years (Fig. 8) was used to estimate the number of nests in blocks that were only counted once.

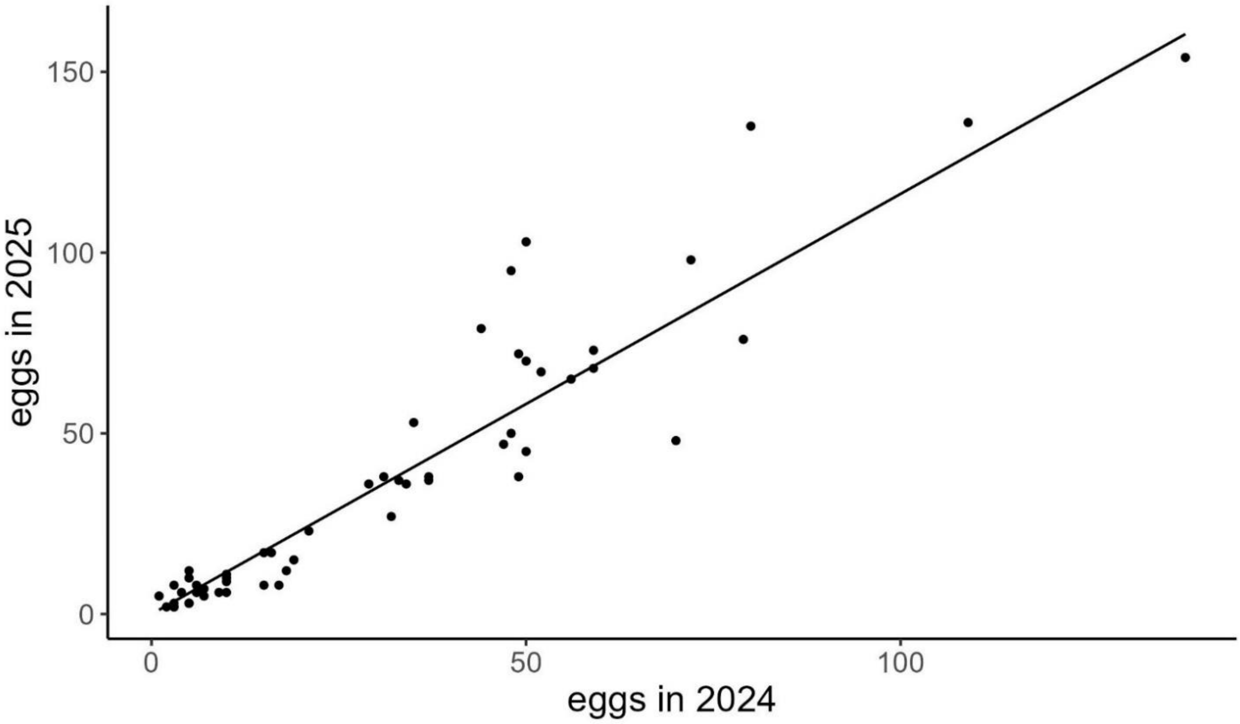

Figure 8. The number of Gibson's albatross nests with eggs estimated in 54 x 15ha blocks that were counted by drone in both 2024 and 2025, and a fitted line (R^2 = 0.879).

To explore whether the change between 2024 and 2025 was essentially the same for all 54 blocks or whether there were real differences between blocks in growth rates between those years, parametric bootstrapping (Efron & Tibshirani 1994) was used to compare the variance of observed growth rates with the variance of simulated replicates generated on the assumption that the only source of variance was Poisson count variation. In particular, 1000 simulated replicate counts of the 54 blocks were generated and the variance of the growth rate between years was estimated for each replicate. The variance of the real data with the simulated data was then compared. The simulated replicates were generated by assuming the parametric density of albatross nests in each block was the same as that observed in 2024, and the parametric density in 2025 was the parametric density in 2024 multiplied by the observed growth rate. Simulated replicates of 2024 and 2025 counts were generated by sampling from Poison distributions with lambdas equal to the parametric densities. Of the simulated replicates, 62.5% had growth rate variances larger than was observed amongst the 54 blocks counted in 2024 and 2025, from which it was concluded variation in growth rates resulted from nothing other than Poisson counting error.

Once the has-egg and lay-fail correction factors had been applied and estimates made for the blocks not counted in both years, the mean number of estimated nests on Adams Island in 2024 and 2025 was 4,497 nests, with confidence intervals ranging 4,458–4,537 nests (best case standard errors) or 4,378–4,616 (worst case standard errors) (Table 5).

Table 5. Estimated number of nests on Adams Island in 2024 and 2025, with lower and upper confidence intervals (LCI and UCI) based on best and worst-case error assumptions of the has-egg rate. The best case assumes binomial SE for each has-egg rate matched to a drone flight, while the worst case assumes a common and larger SE for all drone flights which is the SE of all recorded has-egg rates.

		Best case standard errors		Worst case standard errors	
Year	Estimated nests	LCI	UCI	LCI	UCI
2024	4,130	4,062	4,197	3,904	4,361
2025	4,865	4,823	4,907	4,793	4,929
mean	4,497	4,458	4,537	4,378	4,616

The distribution of nesting albatrosses on Adams Island was very uneven with the densest concentrations of nests (71% of all nests) occurring in the two large basins on the southern slopes of the island (Astrolabe Basin and Amherst Basin in the west ~ 22%; Fly Basin in the east~49%) as shown in the heat map in Fig. 9.

This map confirmed that the three annually counted blocks were indeed generally representative of high, medium and low populations as initially intended, but also visually demonstrated two known patches of less favourable nesting habitat within the high and medium count blocks (Fig. 10). The heat map thus highlighted where future ground counts could monitor the largest number of breeding pairs within the smallest areal extent (ie maximising numbers counted while minimizing count time taken).

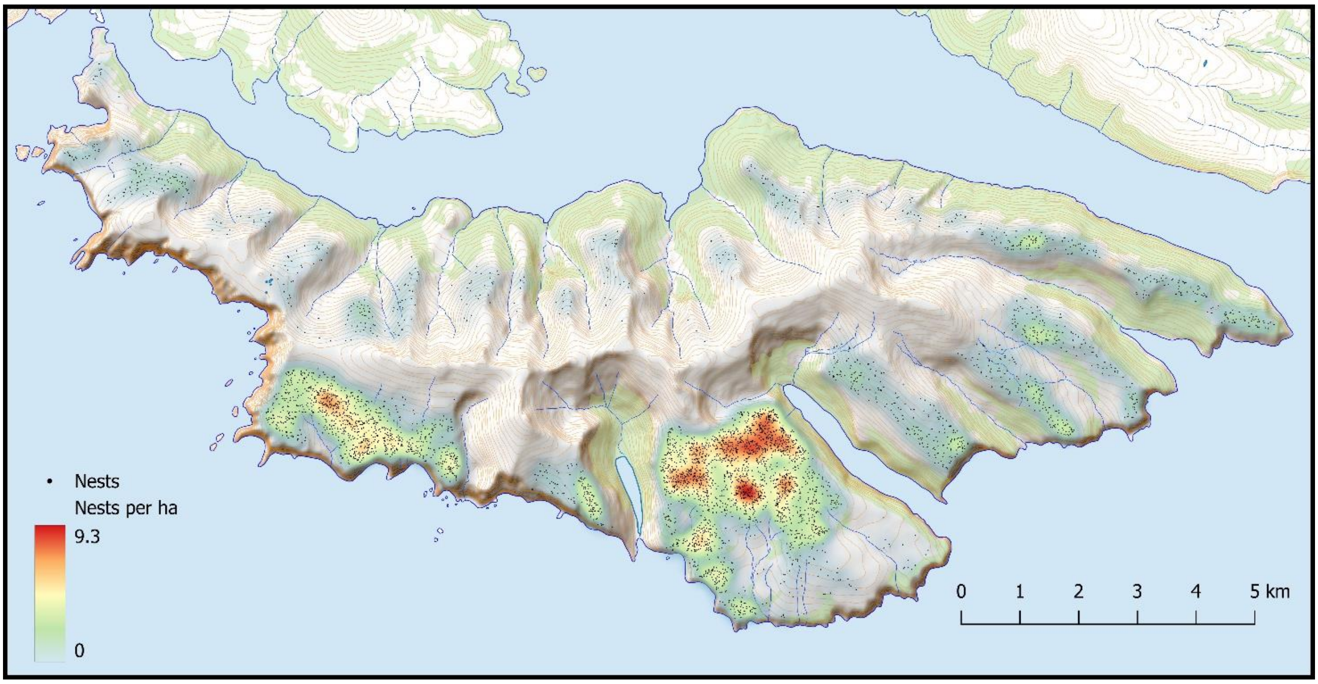

Figure 9. Distribution and density of the 4,865 Gibson's albatross nests estimated to be on Adams Island in 2025

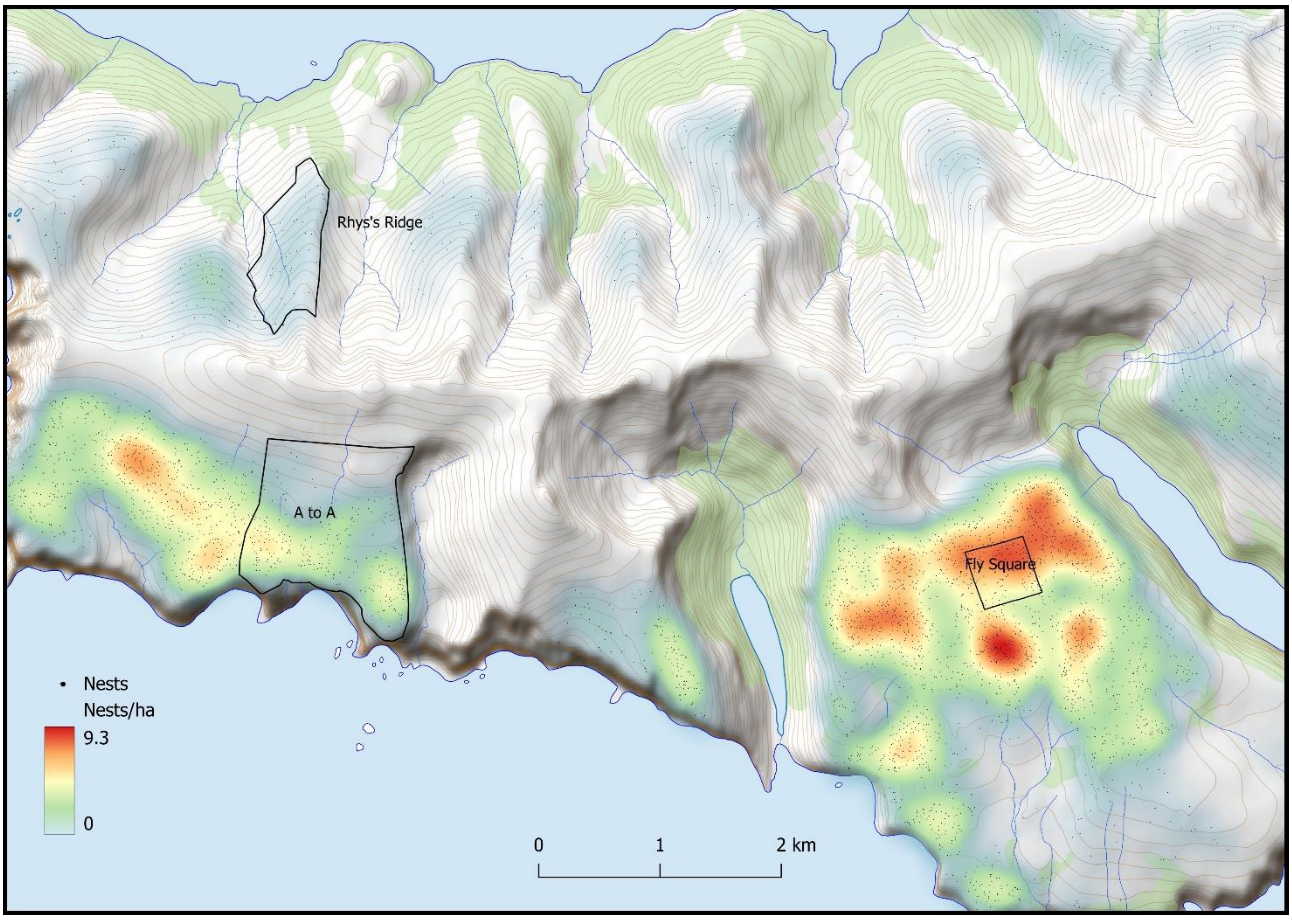

Figure 10. The location of three census blocks ground-counted annually since 1998 in relation to the density of Gibson's albatross nests in 2025. Rhys's Ridge was chosen as representative of low-density nesting, A–A of medium density and Fly Square of high-density nesting, though gradations to areas of low and medium density nesting within A-A and Fly Square respectively are visible.

In addition to the annual counts of 9.5% of the Adams Island population in 1998–2025, and the whole island surveys of 1997 and 2024/2025, an additional area of the Adams Island population was ground counted in 2000 and 2016 (Hamilton et al. 2000; Elliott et al. 2016) as part of efforts to check the three representative blocks were large enough to accurately reflect the whole island population trends.

Astrolabe Basin, adjacent to the annually counted-Amherst Basin (A–A), was estimated from ground counts in 2000 and 2016 to support ~15% and ~ 14% respectively of the 1997-derived estimate of total Adams Island pairs. The drone surveys of the Astrolabe Basin produced estimates it contained ~17.7% in 2024 and ~ 15.33% in 2025 of the island's population (mean=16.42%).

Use of that mean 16.42% proportion to calculate the total number of pairs breeding on Adams Island in 2000, 2016, 2024 and 2025 retrieved essentially the same population trend-line as did the count of the three representative census blocks comprising 9.5% of the total population (Fig. 11).

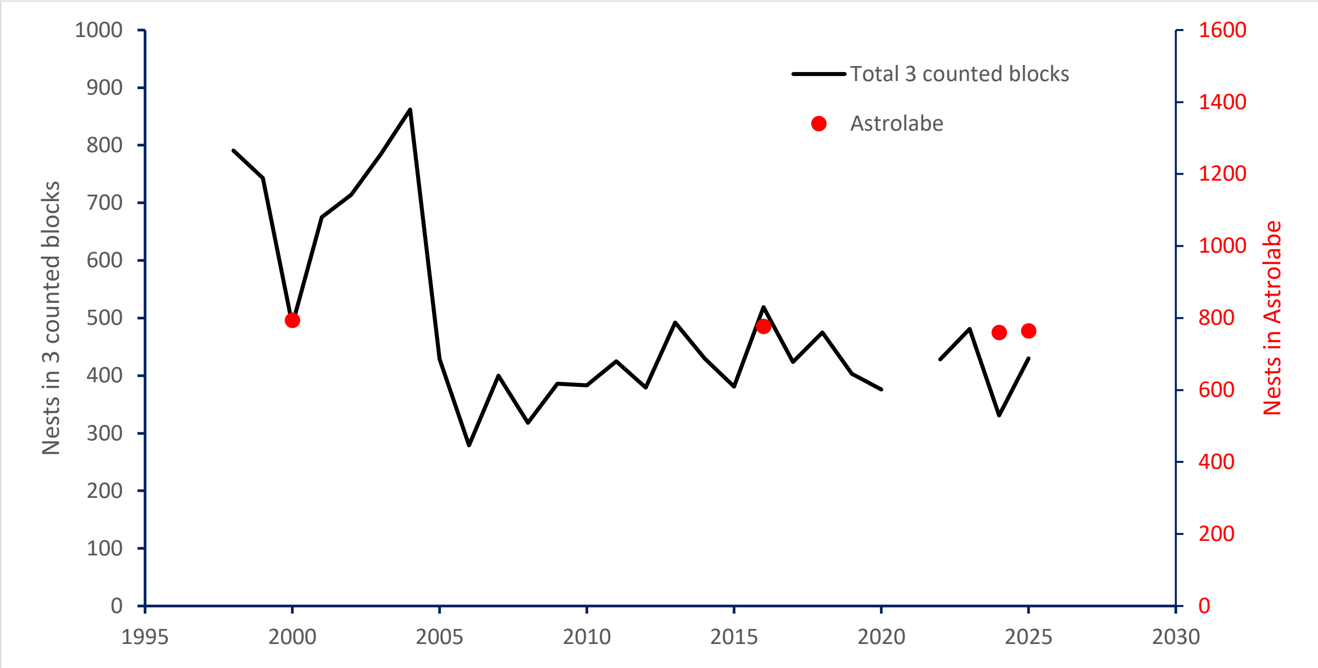

Figure 11. Gibson's albatross nests in three annually counted blocks (9.5% of the Adams Island total – black line, lefthand axis) and Astrolabe Basin counted in 2000, 2016, 2024 and 2025 (16.42 %, solid red dots, righthand axis).

Number of southern royal albatrosses nesting on Adams Island

On 13 January 2025, 13 southern royal albatrosses (11 of them on eggs) were found amongst Gibson's wandering albatrosses while undertaking ground truthing transects on two ridges on south-east Adams Island (Fig. 12). On Bollon's Ridge 6 of 70 birds were southern royal albatrosses and on Royal Ridge 7 of 19 birds were southern royal albatrosses.

On 19 January 2025 both of the upper Fly Basin sites were thoroughly searched but no southern royal albatrosses were found there, and Gilroy Head was unable to be searched on foot in 2025. The current and previous records of southern royal albatrosses on Adams Island are summarized in Table 6.

An island-wide ground-count of Gibson's wandering albatross in 1991 which only missed visiting Bollon's Ridge, found 13 breeding pairs of southern royal albatross, a similar number to that found in 2025 when Bollon's Ridge was counted but Gilroy Head was not. Assuming the numbers at those two sites are similar between years, then perhaps between 15 or 20 pairs of southern royal albatross nest on Adams Island in any one year, too few to cause inflation of the Gibson's albatross population estimate in 2025.

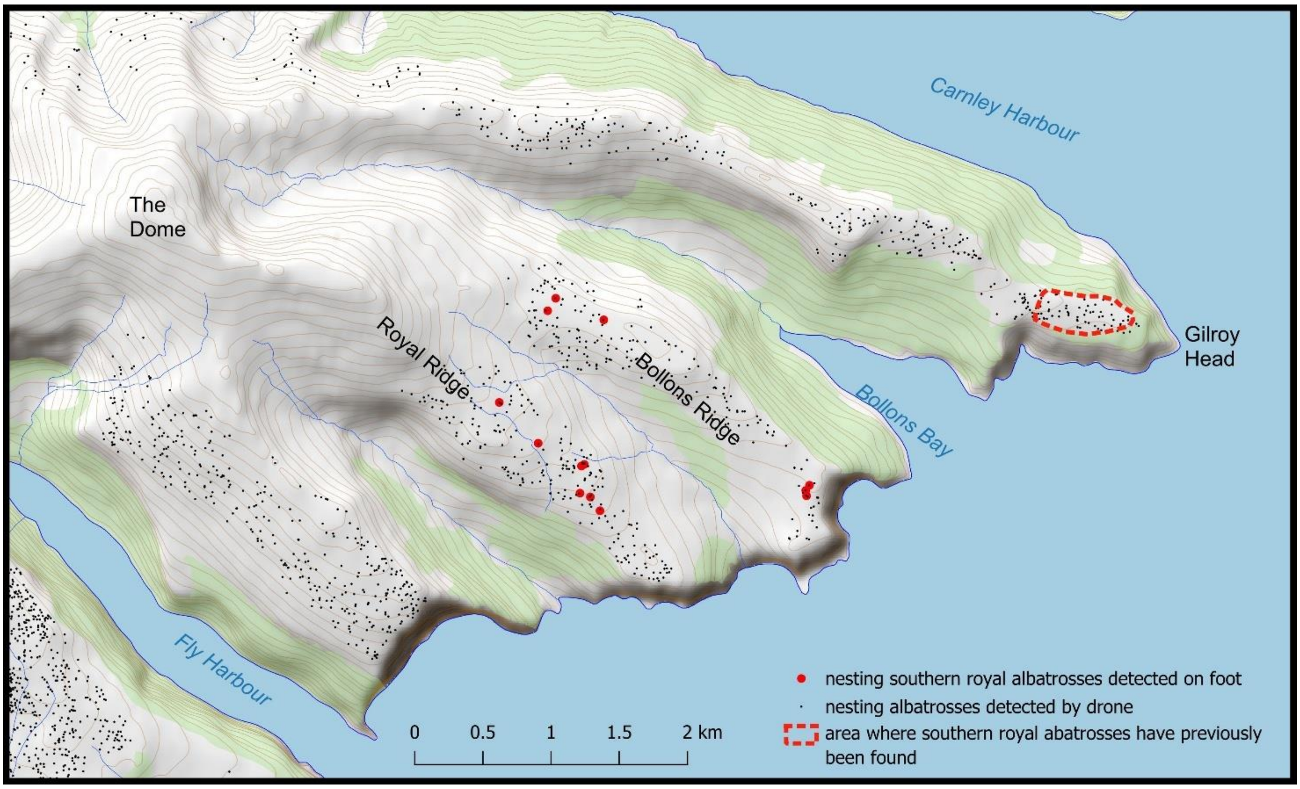

Figure 12. Location of southern royal albatross (red dots) encountered on transects along Bollon's Ridge and Royal Ridge on 13 January 2025 and the 15ha block (dashed red line) at Gilroy Head where small numbers of this species have regularly been reported from in the past. Small grey dots are Gibson's albatross nests mapped from drone photos in 2024/ 2025.

Table 6. Number of southern royal albatrosses seen on Adams Island 1890—2025 (—indicates site not visited)

	1890[1]	1905[2]	1 Feb 1973[3]	25 Nov 1989[4]	17 Feb 1991[5]	14 Feb 1993[6]	1995[7]	14 Feb 1997[8]	13 Jan 2025[9]
Gilroy Head	present	present	7 nests 11 loafers	13 adults	11 nests 15 loafers 4 flying	—	—	—	—
Bollons Ridge	—	—	2 nests	2 adults 1 pair	—	—	—	2 nests	5 nests 1 loafer
Royal Ridge	—	—			1 nest 6 loafers	—	—	—	6 nests 1 loafer
Fly Basin	—	—	7 nests 2 loafers	15 adults	1 nest 3 loafers	1 nest 4 loafers	1 nest	0	0
Fly Sidle	—	—	2 nests	1 pair	0	0	0	0	0

[1] John Fairchild reported by Buller 1891 (Miskelly et al. 2020)
[2] John Bollons (Miskelly et al. 2020)
[3] Robertson (1975)
[4] Buckingham et al. (1991)
[5] Unpublished data held by Kath Walker and Graeme Elliott
[6] Unpublished data held by Kath Walker and Graeme Elliott
[7] Unpublished data held by Kath Walker and Graeme Elliott
[8] Unpublished data held by Kath Walker and Graeme Elliott
[9] This report

At-sea distribution of adults in 2022 and 2024

The average "life" of 29 satellite tags attached to 29 breeding adults (seven of whose nests later failed) in February 2022 was 179 days (range 12–347) (Table 7), while that of 20 satellite tags attached to 12 breeding and 8 failed or non-breeding adults in January 2024 was 251 days (range 111–360) (Table 8). As had been found in earlier deployments, tags generally stayed on longer on successfully breeding birds than non-breeding and early failed breeding birds, as the feathers to which the tags were taped could only be moulted when breeding ceased; that is, once the excessive flying demands of raising chicks were past.

Table 7. The length of time TAV satellite transmitters remained attached to 29 adult Gibson's albatrosses nesting in February 2022 before they fell off, and the survival that year of each bird tracked, known or presumed.

Bands	Sex	Status	Deployed	Stopped transmitting	Duration	Outcome
Black-91c	Male	failed breeder	28/01/2022	9/02/2022	12	Later seen alive
Red-33j	Male	failed breeder	6/02/2022	1/03/2022	23	Later seen alive
Black-45b	Female	failed breeder	5/02/2022	26/03/2022	49	Later seen alive
Red-19j	Male	breeding	6/02/2022	4/04/2022	57	Later seen alive
Black-86d	Female	failed breeder	5/02/2022	3/05/2022	87	Later seen alive
Black-674	Male	breeding	5/02/2022	16/05/2022	100	Later seen alive
Black-77c	Male	breeding	5/02/2022	17/05/2022	101	Later seen alive
Black-536	Female	breeding	5/02/2022	17/05/2022	101	Later seen alive
Black-949	Female	failed breeder	5/02/2022	22/05/2022	106	Later seen alive
Black-02e	Male	breeding	5/02/2022	5/06/2022	120	Successful nest 2022
Black-790	Male	breeding	5/02/2022	7/06/2022	122	Later seen alive
Black-769	Male	breeding	28/01/2022	15/06/2022	138	Later seen alive
Red-43h	Male	failed breeder	6/02/2022	28/06/2022	142	Later seen alive
Black-365	Female	breeding	5/02/2022	29/06/2022	144	Later seen alive
Black-53h	Female	failed breeder	5/02/2022	13/07/2022	158	Later seen alive
Black-239	Female	breeding	5/02/2022	17/08/2022	193	Successful nest 2022
Orange-195	Female	breeding	5/02/2022	21/08/2022	197	Later seen alive
Orange-102	Female	breeding	5/02/2022	28/08/2022	204	Later seen alive
Black-68a	Male	breeding	5/02/2022	3/09/2022	210	Later seen alive
Red-70h	Female	breeding	6/02/2022	10/09/2022	216	Later seen alive
Red-78j	Male	breeding	6/02/2022	1/10/2022	237	Later seen alive
Black-67c	Male	breeding	6/02/2022	18/10/2022	254	Later seen alive
Black-885	Male	breeding	5/02/2022	19/10/2022	256	Later seen alive
Black-19d	Female	breeding	5/02/2022	13/12/2022	311	Later seen alive
Red-14h	Female	breeding	6/02/2022	22/12/2022	319	Later seen alive
Red-19j	Male	breeding	6/02/2022	28/12/2022	325	Later seen alive
Black-542	Female	breeding	5/02/2022	29/12/2022	327	Later seen alive
Black-238	Female	breeding	5/02/2022	29/12/2022	327	Later seen alive
Black-619	Female	breeding	5/02/2022	18/01/2023	347	Successful nest 2022

Table 8. Satellite transmitters attached to adult Gibson's albatrosses during the summer of 2023–2024.

Bands	Sex	Status	Deployed	Stopped transmitting	Duration	Outcome
Black-48k	Male	non-breeding	26/12/2023	15/04/2024	111	Back in SA in 2025
Red-99j	Female	breeding	1/01/2024	11/06/2024	162	Killed by long-liner 11/6/24
Black-86b	Male	non-breeding	6/01/2024	24/06/2024	170	Breeding in SA in 2025
Red-80j	Male	non-breeding	21/12/2023	16/06/2024	178	Back in SA in 2025
Red-73e	Male	Breeding-failed	23/12/2023	20/06/2024	180	Breeding in SA in 2025
Black-504	Male	non-breeding	27/12/2023	2/07/2024	188	Back in SA in 2025
Red-45e	Female	breeding	31/12/2023	5/08/2024	218	Successful 2024 nest
Red-98g	Male	breeding	6/01/2024	1/09/2024	238	Successful 2024 nest
Black-847	Male	Breeding-failed	6/01/2024	7/09/2024	245	Breeding in SA in 2025
Red-51b	Female	Breeding-failed	21/12/2023	27/08/2024	250	Breeding in SA in 2025
Red-48j	Female	non-breeding	7/01/2024	26/09/2024	264	Breeding in SA in 2025
Red-53j	Female	non-breeding	2/01/2024	24/09/2024	266	Back in SA 2025
Red-13h	Female	non-breeding	26/12/2023	23/09/2024	272	Breeding in SA in 2025
Red-52h	Male	breeding	7/01/2024	20/10/2024	287	Successful 2024 nest
Black-01d	Female	failed breeder	7/01/2024	26/10/2024	293	Breeding in SA in 2025
Red-35e	Male	non-breeding	23/12/2023	14/10/2024	296	Not in SA in 2025
Red-41h	Male	breeding	7/01/2024	12/12/2024	341	Chick feeding in SA
Red-70f	Female	breeding	2/01/2024	9/12/2024	343	Successful 2024 nest
Black-52j	Female	breeding	8/01/2024	1/01/2025	359	Successful 2024 nest
Red-687	Female	breeding	7/01/2024	1/01/2025	360	Successful 2024 nest

Twenty-six of the 29 adults tracked in 2022 were seen alive again in subsequent years, while a chick fledged from the nest of the remaining three adults, confirming they too had survived the year (Table 7). Of the 20 adults wearing satellite tags in 2024 all except two survived the year, with 12 seen back on Adams Island in summer 2024/2025 and healthy chicks fledging from the nests of 6 birds (Table 8).

Overlaying the location of the two missing birds at the time of their final satellite transmission and the location of fishing vessels via Global Fishing Watch strongly suggested the 20+ year old female Red-99j whose 2024 breeding attempt (Fig. 13) had failed early, was caught in the mid-Tasman on 11 June 2024 by a long liner flagged to Chinese Taipei (*Fong Chun*) as her satellite transmitter abruptly stopped transmitting only 200 metres from this vessel (Fig. 14). While her mate returned to the breeding grounds in December 2024, she did not, providing further evidence that she died when she met the *Fong Chun* rather than her transmitter coincidentally failing when she met it. The 30+ year old male Red-35e was last seen 130km from a trawler on the Chatham Rise, leaving the cause of his absence and potential death uncertain.

Using very simple known-fate survival statistics (Cooch & White 2022) and assuming that survival probability was the same for all satellite tagged birds and did not vary with time, annual fisheries related mortality was estimated from the number of deaths (1) and the total number of days that the 49 adult Gibson's wandering albatrosses were tracked in 2022 and 2024 (10,204), using this formula:

$$annual\ mortality = 1 - \left(\frac{days\ monitored - deaths}{days\ monitored}\right)^{365}$$

The annual mortality rate of adults over those two years caused by fisheries interactions was estimated to be 3.5% (95% confidence intervals 0.5 – 23%). Confidence intervals are large because although birds were monitored for a long time, there was only one death.

Figure 13. Female Gibson's albatross Red-99j on 2 January 2024 putting the finishing touches to her nest on Adams Island several hours before she laid her egg. She was probably killed 5 months later, and this nest failed.

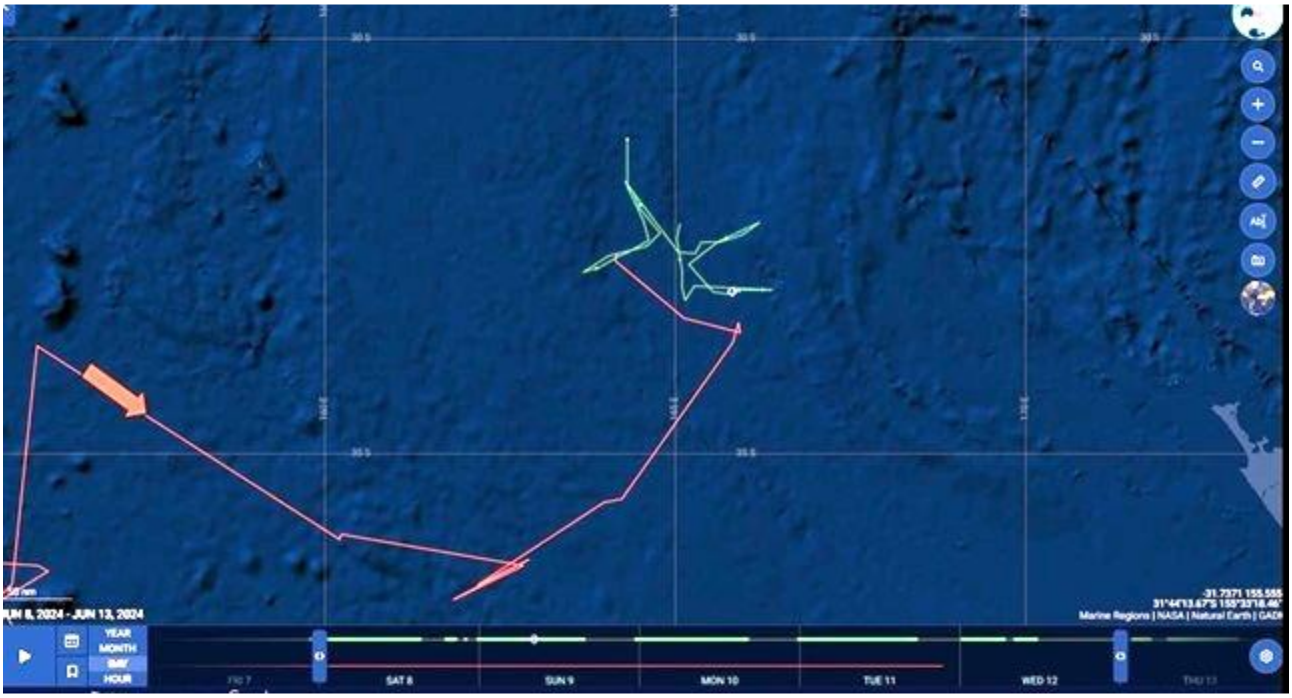

Figure 14. The flight (arrowed pink line) of female Red-99J from 6 June until 11 June 2024 when she met and was almost certainly killed in long lines set for tuna by the *Fong Chun* (green line) which was fishing in the Tasman Sea north-west of the northern tip of New Zealand (just visible at bottom right).

The core of the foraging area used by the 29 adult Gibson's wandering albatross tracked in 2022 and the additional 20 adults tracked in 2024 was similar to that previously reported from a 1995–2004 satellite tracking study (Walker & Elliott 2006; Fig. 15). However, in 2022 and 2024 birds also used areas further north, west and south than had been apparent in the earlier study (Fig. 16).

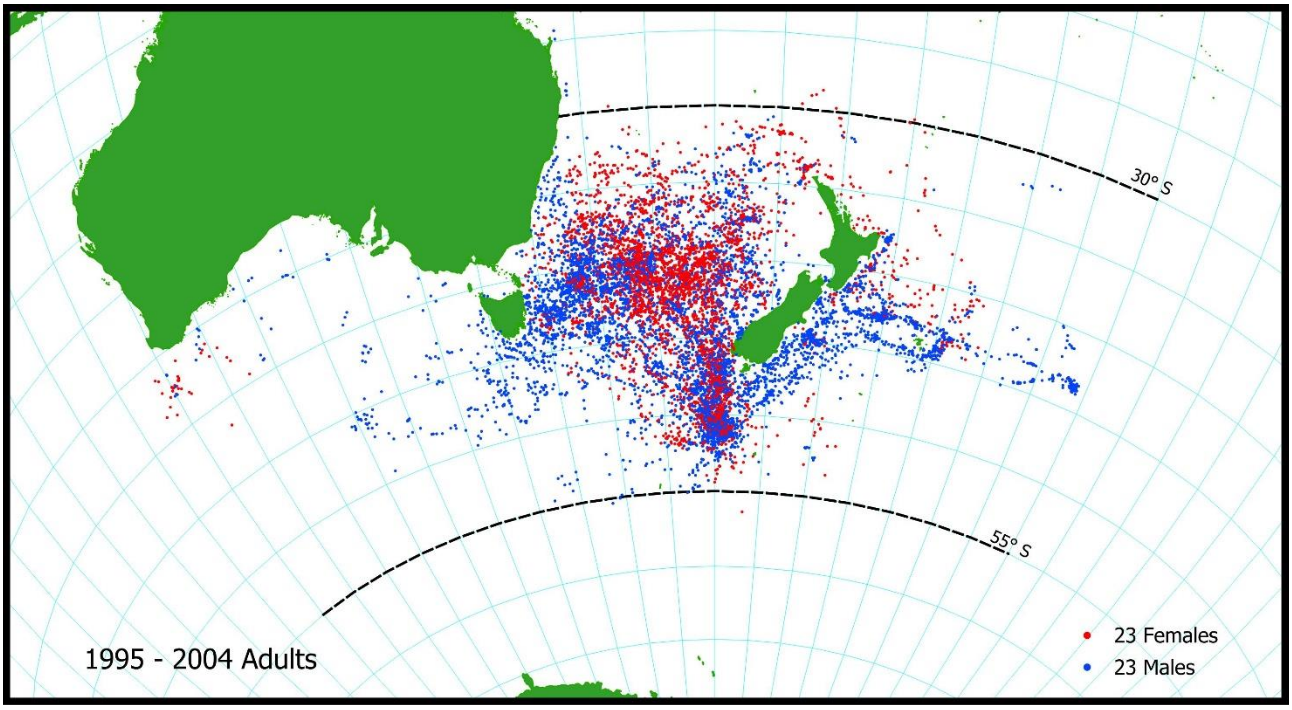

Figure 15. All 10,908 satellite uplinks from 46 adult Gibson's albatross tracked between 1995 and 2003.

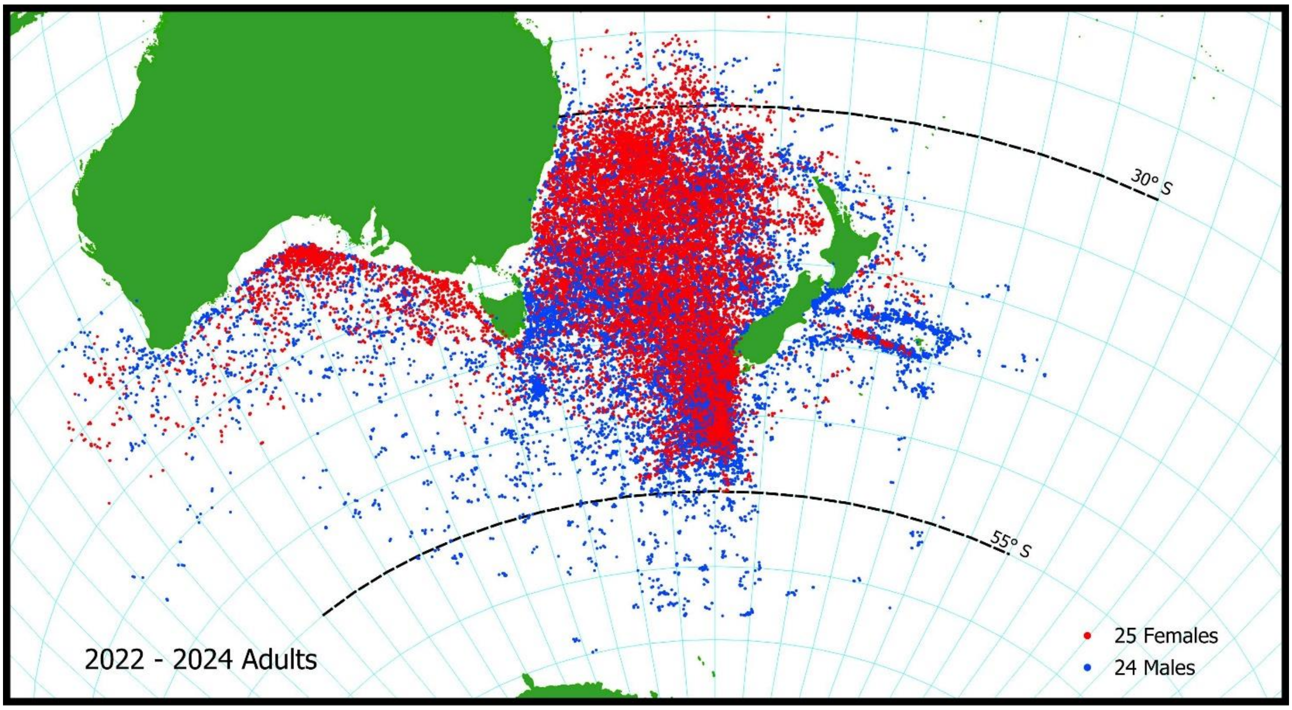

Figure 16. All 67,989 satellite uplinks from 49 adult Gibson's albatross tracked in 2022 (29 birds) and 2024 (20 birds)

Satellite tracking of juveniles in 2025

The 16 chicks to whom transmitters were attached fledged from Adams Island between 11 December 2024 and 7 January 2025, landing on the sea just southeast of the island. This direction is not surprising as most observed first flights appeared to be semi-controlled glides from the land and the predominant wind on Adams Island is from the westerly quarter. Most chicks stayed on the sea where they first landed for a few days before starting long flights northwards, as has been reported in wandering albatross (*Diomedea exulans*) on Crozet Island in the south Indian Ocean (Weimerskirch et al. 2006, Weimerskirch et al. 2014)

Of the 16 juveniles, 15 initially flew up the east coast of New Zealand (Fig. 17), where adults less frequently go. Two flew through Cook Strait into the Tasman Sea (Fig. 17) and by the end of May 2025, ~5 months after they left the breeding grounds, a further 11 had flown around North Cape into the Tasman Sea with only 2 birds remaining to the east of New Zealand.

Only a month after fledging the transmitter on juvenile female B-83K stopped transmitting, and after two months that on female B-88k also stopped. On 17 March the transmitter on male B-85K stopped when he was over the Hokitika Trench, likely caught in the strong northwest gale affecting the area at that time. None of these juvenile birds were close to fishing boats when transmission stopped and presumably died as a result of poor body condition at fledging.

Five months after fledging in late April and mid-May, the transmitters of two more juveniles stopped transmitting within 200km of pelagic longliners flagged to Chinese Taipei and Spain, fishing in the Tasman Sea. The TAV transmitters which both were carrying only provide a few signals every 10 or so hours, and as 200km is within the distance they could be expected to fly between signals, they are likely to have come into contact with those longline fishing vessels.

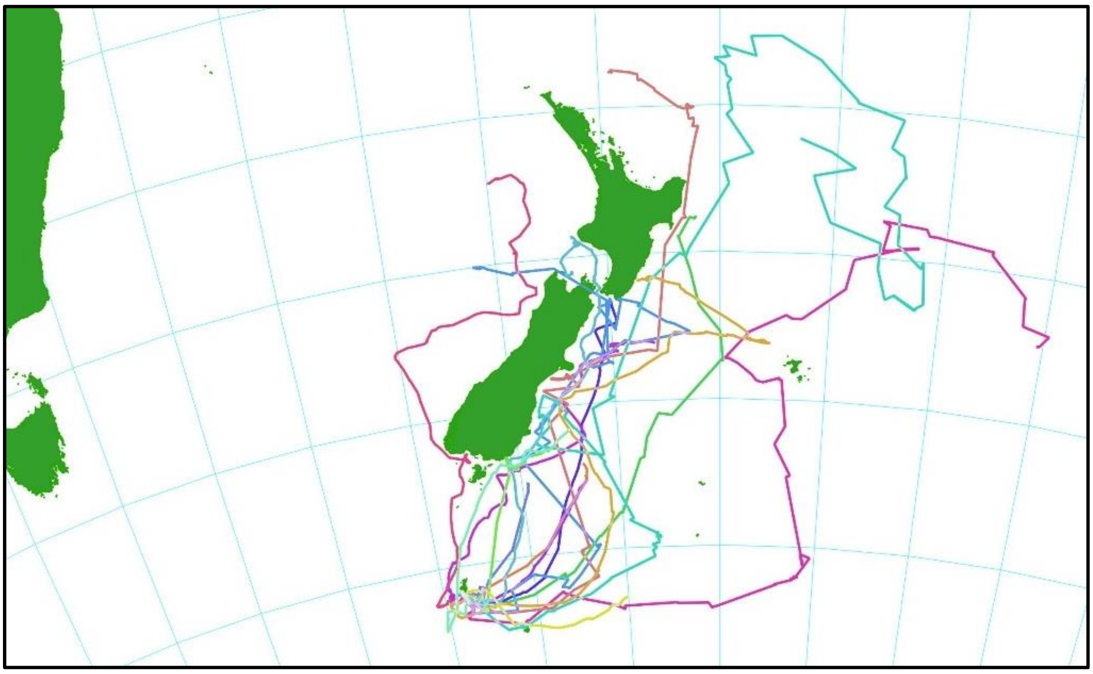

Figure 17. Satellite fixes from 16 juvenile Gibson's albatrosses tracked between December 2024 and 10 January 2025 during the first month after they fledged from Adams Island, with most fledging to the south-east of Adams Island and travelling to the Tasman Sea the long way, via the east coast of New Zealand.

DISCUSSION

At sea distribution

Twenty years after the first satellite tracking study of Gibson's albatross in which the at-sea movements of 46 adults were followed (Walker & Elliott 2006), a second satellite study of adults has been undertaken including 20 adult Gibson's albatross tracked in 2022 and 29 adults in 2024. In addition, in 2025 transmitters were attached to 16 juveniles, which will eventually add to the information gathered from 22 juveniles tracked in 2023 (Walker et al. 2023). Together these studies are providing a detailed picture of the dependence of this subspecies on the Tasman Sea.

Gibson's albatross adults spend more time north, west and south of the Tasman Sea than previously understood (compare Figs 15, 16). The reason for this apparent expansion of range is unclear but probably results from a larger sample size, as was found in analysis of the interannual variability of Antipodean albatross (*Diomedea antipodensis antipodensis*) (Richard et al. 2024). Very similar numbers, genders and life stages of Gibson's albatross were tracked in both the early and later studies, but birds were tracked for shorter periods in the earlier study (2,474 days in 1995–2003 versus 10,051 days in 2022 and 2024). There have been significant reductions in the weight of transmitters and improvements in attachment methods since the 1990's which allow the tags to remain attached to a bird for longer. The apparent extension in range is probably an artifact of an increase in the length of time each individual bird was tracked, although changes to the oceanic environment may also be playing a part.

Whatever the cause, adult Gibson's albatrosses have now been tracked in more northerly waters than in the past, particularly during the winter when long-line fishing fleets move south into those same waters.

The likely fisheries related death of one of the 49 adult birds wearing a satellite transmitter in 2022/2024 provides an alarming estimate of fisheries related mortality annually adding 3.5% to mortality from other causes. Long-lived unproductive species such as wandering albatrosses are sensitive to small changes in adult survivorship (Weimerskirch *et al*. 1997). A 3.5% reduction in adult survivorship caused by fisheries mortality across the population would be more than enough to cause a decline.

Population trajectory

The demography of Gibson's albatross continues to show a worrying lack of recovery following the population crash of 2005/2006. Survival appears to have improved, but mark-recapture modelling continues to suggest the slow growth in the population between 2008 and 2016 has been followed by a period of stasis, and then possible decline.

Detecting slow decline by annual counts of breeding birds is problematic due its inherent variability. The number of Gibson's albatross pairs breeding in 2024 was at a record low (Elliott et al. 2024), and only 46% of those attempting to breed last year succeeded. Many pairs that visited Adams Island in January 2024 did not nest, and many of those who did nest in January 2024 but failed early, returned to Adams Island in January 2025, swelling the number of pairs nesting this year. It may be that 2024 was a single poor year in which unfavourable conditions kept the birds at sea, and that 2025 represents a return to more normal numbers, but those numbers remain stubbornly low.

It remains difficult to accurately determine the current trajectory of the Gibson's albatross population. Interpretation of the last few years data has been hampered by the missed visit to the island in 2021 and by larger confidence intervals around the last few mark-recapture estimates of population size (Fig. 2), normally the most reliable, precise metric. The impact is also apparent in the mark-recapture estimates of survival, where larger confidence intervals in recent years make it difficult to guage survival rate trajectories, although survival estimates appear to be improving for both males and females.

The ability of the population of Gibson's albatross to recover is inhibited by the small pool of available new recruits, the result of the 2006–2012 post-crash period, when numbers breeding and breeding success were both low and small numbers of chicks fledged. Productivity finally picked up in 2016, but it will take another 3 years until the first larger cohort reaches breeding age.

With the advent of global tracking of fishing boats in real time, and long duration satellite tracking of wandering albatrosses, it's become possible to calculate coarse estimates of the percentage of the Gibson's albatross population which is being killed at sea. There is considerable overlap during the winter months of pelagic longliners with not only adult Gibson's albatross, as found in 2022 and 2024 (Richard et al. 2024), but with juveniles (Elliott et al. 2024) in the northern Tasman Sea, and this is likely further depressing the number of new recruits to the breeding population on Adams Island.

A better assessment of the current population trajectory could be made by estimating juvenile survival, as well as adult survival and productivity and producing a population model of the entire population as was undertaken a decade ago by Francis et al. (2015), but is beyond the scope of this report.

Size of the breeding population on Adams Island

The whole island drone-based population size estimate produced estimates of the number of breeding pairs on Adams Island in 2024 of 4,130 and in 2025 of 4,865 breeding pairs, with a mean of 4,497 breeding pairs annually. This is approximately 520 pairs greater than would have been estimated from the 1997 whole island ground census and subsequent annual counts of three blocks.

These two estimates are remarkably close, given the profound differences in count method involved. That they do differ comes down to improved knowledge of where albatrosses nest on Adams Island and therefore the proportion of the albatross population the three census blocks contain, and to more accurate ways of measuring this proportion. The island-wide GPS mapping of Gibson's albatross nests in 2025 also identified ways the proportion of the island counted annually could be increased without substantially increasing effort, and it is recommended that issue be explored in 2026.

Comparison of the whole island count methods: Both ground count and drone photography required the support of a boat as Adams Island is too big to survey from a single location (the hut). The drone photography required extra specialist equipment (drones) and much more desk time than the ground count did, preparing flight programmes, wrangling the resultant data and counting the birds on the photos. It was arguably more expensive. It also required calmer, clearer weather, always at a premium in the subantarctic. However, the drone photography was less physically onerous and more accurate in terms of coverage than the counts on foot. Counts made on foot miss quite a few birds in deep tussock, while the drone photography appeared to miss very few – almost all nests were visible from above in the type of vegetation and topography Gibson's albatross nest in. But the ground counts are counts of nests, while the drone counts are counts of birds which must be corrected for the proportion of birds on the ground which are not on a nest incubating an egg and this correction added uncertainty to the estimates.

CONCLUSION

1) Recovery of the reduced population of Gibson's albatross remains slow and uncertain, with a limited pool of potential new recruits and intermittent years of low breeding success.

2) Satellite tracking of 49 breeding and nonbreeding adults of both sexes in 2022 /2024 has provided updated detailed information on the spatial and temporal distribution of adult Gibson's albatrosses, and an indication of the potential scale of their bycatch in long-line fishing operations.

3) The completion in 2025 of a drone-based estimate of the number of annual breeding pairs of Gibson's albatrosses on Adams Island, many years in the preparation, has provided a more detailed and complete picture of their distribution across the island, and an updated estimate of the size of the population.

4) Together the updated population estimate, and improved knowledge of at-sea distribution allowing more accurate estimation of overlap with surface long line fishing effort, provide key input data for future modelling of the current risk of fisheries to Gibson's wandering albatross.

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