Conservation Services Programme (CSP)

Population studies of southern Buller's albatrosses at Tini Heke | The Snares

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Executive Summary

This report presents the results of demographic studies of southern Buller's albatrosses *Thalassarche bulleri bulleri* breeding at Tini Heke | The Snares from 26 February to 22 March 2026. A whole-island count of the numbers of breeding pairs on North East Island and Broughton Island was attempted. This was largely successful, as ~78.5% of the Snares population was counted (South West Promontory and Alert Stack could not be fully counted). A total of 6,041 occupied nests was estimated in counted areas on North East Island. A comparison of the estimates from comparable areas showed a decline from 5,812 pairs in 2014 to 5,296 in 2026, a decrease of 9% over the 12 years. The estimated number of breeding pairs on Broughton Island was 680, similar to the 621 pairs estimated in 2019. When accounting for unsurveyed areas and applying a correction for vantage-point counts, the Snares southern Buller's albatross population was estimated at 8,194 breeding pairs in March 2026.

Demographic studies at the three study colonies on North East Island have been undertaken annually 1992–2026, with the exceptions of 2018 and 2021. Estimates of the numbers of breeding pairs in 2026, made by recording the contents of each nest mound, increased in all three study colonies compared to 2024, but numbers remain below the levels recorded 2010–2023. Assuming that the three study colonies are representative of changes across North East Island as a whole, the Buller's albatrosses breeding population probably peaked in 2005–2006 and has since undergone marked annual variations, with a general decrease since 2010. To increase coverage, a new study area was established at South Punui, bringing the annually-monitored population to 3.6% of the whole.

A total of 422 birds that had been banded previously in the study colonies as breeding adults of unknown age were recaptured. A further 56 breeding birds were banded in the study colonies, presumed to be first-time breeders. The estimate of adult survival in 2025 was 0.85, one of the lowest recorded during the 34 years of this study. During 1992–2004 all chicks that survived to near-fledging in the study colonies were banded and their survival to return to the study colonies in subsequent years has been monitored. This year, 128 of these birds were recaptured, with 7 birds from cohorts banded in 1998 and 2004 recorded as breeding for the first time. This highlights the long-term monitoring required to obtain reliable estimates of survival of known-age birds across life cycle stages. In addition, five birds banded as near-fledging chicks in the study colonies in Sep 2013 and 2014 were recorded breeding for the first time. The process of fitting

metal-banded birds with alphanumeric darvic bands was continued (darvics were fitted on 346 newly banded or recaptured birds).

Furthermore, tracking devices for high-resolution insights into foraging behaviour and flight characteristics were fitted on 28 Buller's albatrosses. Seven were also paired with TDRs to record sub-surface behaviour. Finally, nest cameras to record data on breeding timing, productivity and nest survival rates were maintained, with 11 nest cameras recording for a further year.

Key recommendations are to extend the area covered by annual counts (including the area from the hut to the tip of the North Promontory) for more-precise trend estimates; and to record more resightings of banded birds to maximise the quality of key demographic parameter estimates by allowing for longer trips going forward.

Introduction

Southern Buller's albatross *Thalassarche bulleri bulleri* tops the list of at-risk species in the updated NZ fisheries risk assessment (Edwards *et al.* 2023). Southern Buller's has an estimated 728 deaths each year in domestic fisheries alone, which exceeds what can be sustained by the population over the long term (Edwards *et al.* 2023), and mortalities outside NZ waters more than double the losses to the population (e.g., 1143 captures each year, Peatman *et al.* 2019).

The Tini Heke | Snares Islands population of southern Buller's albatross has been in gradual decline since the mid-2000s (Sagar *et al.* 2025; Fischer *et al.* 2026). This is known from a demographic mark-recapture study initiated in 1992 and continued every year since then, apart from 2018 and 2021, which provides quality long-term data on key demographic parameters (adult survival, breeding frequency, recruitment) (e.g., Sagar *et al.* 2000). Mark-recapture in the study colonies remains the most powerful way to detect trends for Buller's albatross; however, whole-island counts are helpful to periodically check that the study colonies remain representative of the whole island population. The last whole-island count was conducted in 2019/20 (Thompson & Sagar 2020), so we revisit the effort to obtain a new whole-island estimate.

To understand changes and risks at sea, another focus of work at The Snares is building on what is known of the at-sea distribution of southern Buller's albatrosses (e.g., Sagar & Weimerskirch 1996; Goetz *et al.* 2022; Fischer *et al.* 2023) and providing updated high-resolution insights. The focus of tracking studies is the distribution, foraging behaviours (including diving behaviours), and flight behaviours of the birds. The latter is part of a broader collaboration with Monash University and the Australian Department of Climate Change, Energy, the Environment, and Water (DCCEEW) to better understand seabird use of the flight space around potential offshore wind farms.

Project Objectives

This project is listed as POP2023-02 in the CSP Annual Plan 2025-06, which includes the following relevant objectives:

- Monitor key demographic parameters of southern Buller's albatross (adult survival, breeding probability, breeding success, and population size) on the Snares Islands to reduce uncertainty in risk estimates from commercial fishing and to measure the success of management interventions.
- Provide updated, high-resolution insights into the at-sea distribution of adult southern Buller's albatrosses from the Snares.
- Describe the diving behaviour of southern Buller's Albatrosses from the Snares Islands using time depth recorders (TDRs).

In addition to these specific CSP objectives, the following objectives were included and supported through other means:

- Fit albatrosses with devices that can provide novel, high-resolution insights into at-sea distribution, foraging behaviour and flight characteristics of adult southern Buller's albatrosses (Supported by Monash and DCCEEW).
- Obtain estimates of breeding success and failure rates for the southern Buller's albatross population using remote cameras (supported directly by DOC).
- Collect up to 10 sooty shearwater (*Ardenna grisea*) carcasses/wings for an assessment of population connectivity (supported by Manaaki Whenua Landcare Research and DOC).

Methods

Logistics

Tini Heke | The Snares (48°01'S, 166°36'E) comprises North East Island (280 ha) and Broughton Island (90 ha), plus numerous islets and stacks (Fig. 1).

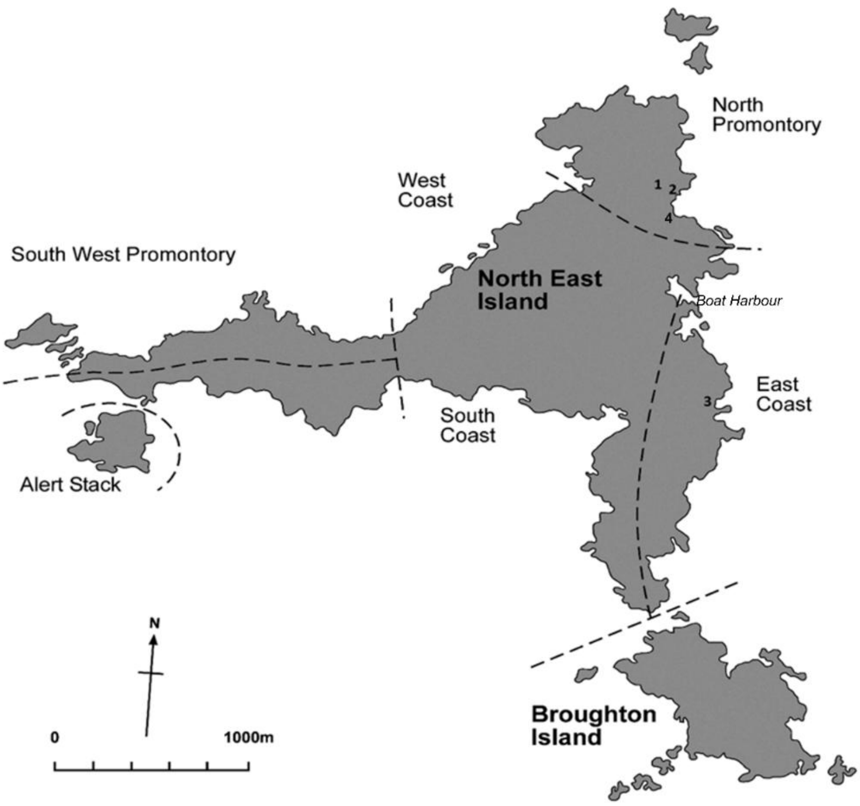

Figure 1. Tini Heke | The Snares, with North East Island study colonies: 1, Upper Punui Bay; 2, Lower Punui Bay; 3, Mollymawk Bay; 4, South Punui. Dashed lines are boundaries of areas for whole-island counts of breeding pairs of southern Buller's albatross.

Transport to and from The Snares was provided by the SV *Evohe* (skipper, plus 3–4 crew). The field team (comprising Kalinka Rexer-Huber, Graham Parker, Te Arawhetu Waipoua and Paul Sagar) were dropped off at Boat Harbour at about 15:30h on 26 February 2026. The *Evohe* then returned to Bluff before returning to The Snares on 19 March to provide transport to Broughton Island on 20 March, returning the whole field team to Bluff on 23 March.

Whole-island counts

Counts

The laying period of southern Buller's albatross at The Snares extends from late December to the end of February, with most of the eggs laid by late January (Sagar & Warham 1998). Therefore, the timing of counts was scheduled for close to the end of laying, when few nest failures have yet occurred. The counts of incubating birds on North East Island and adjacent islets and stacks took place 28 Feb–17 Mar, with the count on Broughton Island completed on 20 Mar. Southern Buller's albatrosses are monogamous, usually nest annually, and do not re-lay within a season if the single egg laid is broken (Sagar & Warham 1998). Therefore, counts of incubating birds shortly after lay, plus broken or abandoned eggs, are presumed to represent the total number of pairs of birds breeding each year. It is useful to include recent failures because unlike at other colonial albatross colonies in the New Zealand subantarctic, predation of albatross eggs by southern black-backed gulls (*Larus dominicanus*), red-billed gulls (*Chroicocephalus novaehollandiae*) and subantarctic skuas (*Stercorarius antarcticus*) has not been recorded at The Snares. Therefore, egg remains were included in the estimated total numbers of breeding pairs, as in previous years, providing comparable data across all years despite variation of up to a month in the timing of visits.

When counting incubating birds we followed the procedure used on the five previous occasions that whole-island counts had been undertaken 1992–2020, which was similar to that used in 1969 (Warham & Bennington 1983; Sagar *et al.* 1994; Sagar *et al.* 1999; Sagar & Stahl 2005; Sagar 2014; Thompson & Sagar 2020). The islands were divided into sections, based on maps prepared from aerial photographs. Using the same count maps as for previous whole-island counts (purple, Fig. 2), each section was covered systematically in a search for breeding albatrosses.

On both North East Island and Broughton Island, ground counts were completed wherever access to nests was possible. Counters systematically searched for nests, moving through the forest roughly in parallel as the vegetation allowed, and checking with each other to ensure nests were not missed. Included in ground counts were birds incubating an intact egg (assumed to be all birds sitting tightly on a nest mound, with the majority checked for an egg), and nests with an abandoned or broken egg or an egg that had rolled out of the nest. Nests counted were sprayed with stock marker to avoid duplicate counting. Birds breeding in inaccessible areas were counted from vantage points, at distances up to 500 m, using binoculars. In such situations counts were made by 2–4 observers independently and averaged. Abandoned and broken eggs could not be counted from vantage-point counts, so totals from these counts are considered to represent the minimum number of breeding pairs.

When completing ground counts, as many birds as possible were checked for leg bands. This information was used to estimate the dispersal of birds banded in the study colonies.

Total breeding pairs in March 2026

Since it is not possible to determine via binoculars whether apparently nesting albatrosses (ANA) had an egg in the nest cup, vantage-point counts are inherently less accurate than ground counts of nests with known contents. To account for this, we estimated the proportion of ANA actually sitting on an egg (the has-egg rate) via nest-checks concurrent with vantage-point counts. For detail, see Appendix A.

Vantage-point counts for each survey map were then corrected with the day's has-egg rate and added to the known number of nests with eggs (ground count total), then summed for a total estimate of the number of breeding pairs of Bullers albatrosses present on The Snares in March 2026.

Importantly, this estimate will not be comparable with totals from previous whole-island counts (unless additional adjustments are made, see below), because vantage-scan counts have previously been reported as raw counts, rather than corrected for has-egg rates. However, as a stand-alone estimate, it may be useful as the most accurate estimate we can obtain for the number of Bullers pairs breeding at the time of survey in March 2026.

Trends

We consider population trends in two ways. Firstly, in the same way they have been previously (e.g., Sagar 2014; Thompson & Sagar 2020): comparing raw counts (ground-counted, with recent breeding failures included, and vantage-point scan counts) over time in comparable areas. That is, only areas counted on every survey occasion were compared, excluding areas that could not be covered in some years.

Secondly, trends for southern Buller's albatross numbers across Tini Heke | Snares were plotted following the approach in Fischer *et al.* (2026). In brief, following a standardised abundance processing framework, all existing data for southern Buller's albatross from The Snares were transformed into annual breeding pairs at the start of the breeding period using a series of generalised linear mixed-effects models, while uncertainty (including on the status of breeding pairs counted through vantage point counts, as above) was propagated accordingly in a Bayesian modelling approach. For detail, see Fischer *et al.* (2026). A Bayesian state-space model was then fit to the standardised abundance estimates to provide a continuous timeseries, while continuing to communicate uncertainty.

Study colonies

Each of the three study colonies was visited 4–5 times; Upper & Lower Punui Bay 27 Feb and 5, 11,17 and 21 March; and Mollymawk Bay 2, 7, 14 and 19 March.

On the first visit to each colony, all nests were inspected, and the contents recorded. The presence of an abandoned or broken egg was also recorded. Leg band numbers of all adult birds associated with study colony nests were recorded, and any incubating unbanded birds were captured and fitted with a uniquely numbered stainless-steel band and alphanumeric darvic band (black text on white darvic), and standard measures of minimum bill depth and tarsus width taken for sexing following Sagar *et al.* (1998). All adult birds recorded on this first visit were marked with raddle (a temporary stock marker) so that they were recognisable and not captured on a subsequent colony visit. On the second and subsequent visits to each colony, all nests were checked again and any birds not marked with raddle had their band details recorded. In addition, on each visit an attempt was made to identify as many as possible of the banded non-breeding birds that were loafing or occupying an empty nest in the colonies.

To increase the banded proportion of the southern Buller's albatross population at The Snares that is monitored (the current study colonies represented 3.2% and 4.8% of the population during last whole island counts 2014 and 2020, respectively), an additional study colony was established, picking the well-defined breeding colony at South Punui Bay. During Feb–Mar 2026 unbanded incubating birds were captured and fitted with a uniquely numbered stainless steel band and plastic alphanumeric band on each leg. The recapture history of some birds in South Punui Bay was already known, since near-fledged chicks had been banded in this colony in 1992, 1994, 1997, 1998, 1999 and 2001, so we also recaptured as many of these previously banded birds as possible and fitted them with an alphanumeric band.

All banding data (newly banded birds plus recaptures) have been submitted to FALCON, the banding database operated by the Department of Conservation, Wellington.

Survival estimation

Survival was estimated from the banded birds with maximum likelihood mark-recapture statistical methods using MARK via the R package RMark (White & Burnham 1999; Laake 2013; R Core Team 2026) and the standard Cormack-Jolly-Seber model. As best as possible, methods followed the approach used for previous southern Buller's albatross survival analyses from The Snares (Thompson & Sagar 2022; Thompson & Sagar 2023). The model was run using data from 1,775 breeding birds banded 1992 to 2025, including data on sex assigned using the measurement of minimum bill depth and tarsus width (Sagar *et al.* 1998), and by cross-referencing with the partner of each bird, where this was known. There were no field visits to the island in 2018 and 2021, so survival has not been estimated for these years.

We first tested a range of models for best fit, comparing models using AICc. Specifically, we created models where both survival and resighting probability (or detection probability) either varied by time, sex, time and sex, or were held constant. Annual survival was then estimated using the best-fitting model.

Tracking

To better understand foraging distribution and fisheries risks (CSP POP2025-02 objective), as well as albatross flight characteristics around potential offshore wind farms (supported by Monash University and DCCEEW), satellite transmitting trackers (Druid YAWL Argos or UBLINK), some of which also held pressure sensors, were deployed on 21 breeding Buller's albatrosses 4–16 Mar 2026. These were securely attached to back feathers with Tesa tape for long term deployments (that is, until feather moult causes the loss of the device). We also aimed to recover the remaining eleven GLS of the 26 deployed in 2024 (Sagar *et al.* 2024; Sagar *et al.* 2025).

To build the dataset of late-incubation foraging range and diving behaviour during Feb–Mar, combinations of GPS and dive-depth loggers (IgotU and TDR) were deployed on five breeding southern Buller's albatrosses and a further two carried only TDR. The TDR recorded pressure data at 1s intervals and a log of wet/dry periods. IgotU were secured to back feathers with Tesa tape, and TDR were leg-mounted. These deployments were short-term, needing to be recovered during the trip.

Pressure measurements in recovered TDR were processed following methods in Düssler *et al.* (2026), using the *diveMove* package in R (Luque & Fried 2011; Luque 2024; R Core Team 2026) to filter out erroneous pressure fluctuations and identify dives (minimum dive depth of 1 m to separate actual dives from noise). Dive phases were then identified (e.g., descent, bottom phase, ascent), allowing descent rates to be calculated from descent distance and descent time.

Nest cameras

Trail cameras to study the breeding biology, phenology, and success of Buller's albatrosses at the Snares have been collecting data since 2022 (Thompson & Sagar 2022). Nestcams deployed in 2025 (16 nest cameras) were checked, with the SD cards and batteries replaced where applicable to continue taking an image every hour during daylight hours year-round. Wherever possible, the cameras were redeployed in the same locations. However, for some cameras doing so would have produced coverage of too few occupied nests, and so they were re-positioned to allow for a greater number of nests to be surveyed. In all cases, active nests in the field of view of each nest camera were recorded when it was restarted.

Results

Whole-island counts

A total of 6,721 occupied nests, including 23 recent failures, were counted on North East and Broughton Islands (6,041 on North East and 680 on Broughton) over the course of nine survey days during 28 Feb–20 March (Fig. 2, Table 1). Coverage was not complete since unsafe terrain prevented access to the far side of the South West Promontory, therefore, this area and Alert Stack (which is counted from SW Prom) were not covered during the whole-island count (maps 12–16, Fig. 2). However, the counted area covered approx. 78.5% of the total population.

If the estimates for Alert Stack, and the north and south sides of the South West Promontory are excluded, on the basis that these areas were not surveyed completely (greyed rows, Table 1), then the total for North East Island was an estimated 5,296 occupied nests (*italicised*, Table 1). This compares to estimates of 2,844, 4,930, 5,571, 6,134, and 5,812 nests for the same areas covered in 1969, 1992, 1997, 2002 and 2014, respectively (*italicised*, Table 1). These changes in comparable areas indicate that the population increased through to 2002 and has since declined.

Totals for Broughton Island 1992–2026 show showed little difference between 1992 and 1997, followed by an approximate 26% increase by 2014, with numbers then remaining stable 2019 and 2026 (Table 1), compared to North East Island.

To make counts over time comparable across all of North East Island and Broughton Islands, areas that could not be counted in a given year had nest numbers estimated (Broughton in 2002; parts of NE Island in 2019/20 and 2026; estimates in parentheses, Table 1). For detail see Appendix A.

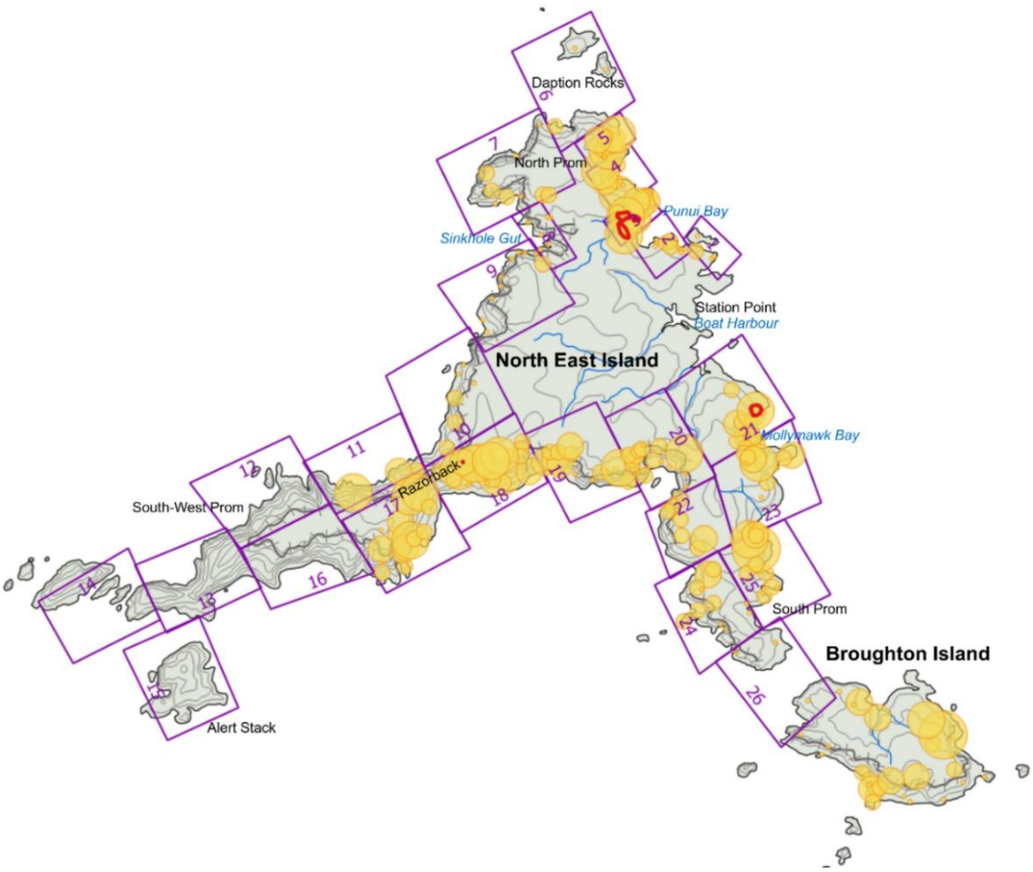

Figure 2. Buller's albatross colony size and distribution on Tini Heke | Snares in Feb-March 2026. Yellow points: raw ground- and vantage-point counts, with point size scaled by nest number recorded at that point. Purple polygons: approximate boundaries of historic count maps. Bold red: study area boundaries.

Table 1. Numbers of occupied nests of southern Buller's albatrosses counted in different areas of The Snares, 1969–2026. Occupied nest totals include recent failures. Values in parentheses include estimates for uncounted areas (NC), using the rates of change in areas counted. *, incomplete counts. *Italicised*, North East Island totals for just those areas counted in full in 2026. Correction for difference in dates of 2019/20 count detailed in Thompson & Sagar (2020). Data for 1969–2002 are from Sagar & Stahl (2005), 2014 from Sagar (2014) and 2019/20 from Thompson & Sagar (2020).

Area/Year	1969	1992	1997	2002	2014	2019/20	2026
North Promontory	509	1,108	1,400	1,643	1,508	1,758	1,536
West Coast	121	262	317	205	146	193	142
North side, SW Promontory	305	785	520	739	427	NC	151*
South side, SW Promontory	763	1,236	1,410	1,025	1,201	NC	594*
Alert Stack	112	193	223	267	305	NC	NC
South Coast	1,425	2,095	2,161	2,554	2,425	1,562*	2,226
East Coast	789	1,465	1,693	1,732	1,733	1,665	1,392
Total NE Island	**4,024**	**7,144**	**7,724**	**8,165**	**8,047**	**5,178***	**6,041***
Comparable areas 1969–2014, 2026	*2,844*	*4,930*	*5,571*	*6,134*	*5,812*		*5,296*
Broughton Island	NC	539	518	NC	657	621	680
TOTAL	**4,024* (4,448)**	**7,683**	**8,242**	**8,165* (8,713)**	**8,704**	**5,709* (8,831)**	**6,721* (8,556)**

In 2026, 4,154 nests were ground counted and 1,865 vantage point counted (Table 2). Considering the ground-count and vantage-point totals made 1992–2026, ground-count totals increased over time, whereas the vantage-point totals remained similar from 1992 to 2002, but decreased by 2014. There is rarely opportunity to quantify detectability in vantage-point counts, since they are typically conducted where access for ground counts is not safe. However, at one site where both methods were possible, vantage-point counts showed 9 occupied nests and one maybe-occupied (looked to be incubating but not definite) while ground counts by another observer found 9 birds on egg.

When trends in annual breeding pairs are standardised and modelled across Tini Heke | The Snares as a whole (Fig. 3), the trajectory remains clear: the southern Buller’s albatross breeding population peaked in the early 2000s and has declined since.

Table 2. Ground counts and vantage-point counts southern Buller's albatrosses on North East Island, The Snares. In parentheses, % of total; *, partial count only.

Year	Ground count total	Vantage-point total	Whole island total
1992	3,779 (53%)	3,365 (47%)	7,144
1997	4,332 (56%)	3,392 (44%)	7,724
2002	4,855 (59%)	3,310 (41%)	8,165
2014	4,971 (62%)	3,076 (38%)	8,047
2019/20*	3,834 (74%)	1,344 (26%)	5,178
2026*	4,154 (69%)	1,865 (31%)	6,041

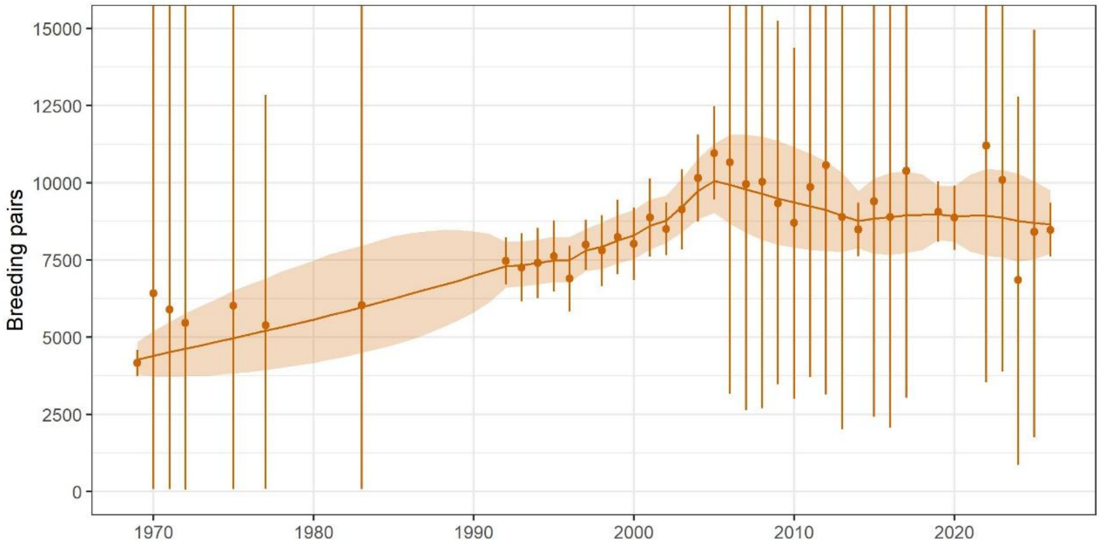

Figure 3. Trends in annual breeding pairs of southern Buller's albatrosses at Tini Heke | The Snares derived through a standardised abundance processing and modelling framework (Fischer *et al.* 2026). Symbols with error bars represent medians and 95% credible intervals of individual abundance estimates, line with translucent ribbon represents median with 95% credible intervals produ ced by a Bayesian state-space model. Smaller error bars are associated with a higher proportion of the population counted.

In 2026 we also collected data to correct vantage-point counts for the number of albatrosses not actually incubating (Appendix A). Nest-contents data showed that the has-egg rate ranged widely from 70% to 90% across the nine distinct days and areas checked (median sample size 410 nests, from a total of 3,094 nests checked; Table A2). To keep estimated nesting numbers as accurate as possible, we applied concurrent data; that is, has-egg rates from the day and area of vantage-point counts.

Using the raw ground count of nests with eggs, estimated numbers from uncounted areas, and with a correction for has-egg rate applied only to the counts from vantage points, we estimate that in March 2026 there were 8,194 pairs (7,494–8,895) of Buller's albatrosses breeding on Snares Northeast Island and Broughton Island. Importantly, this estimate can only be seen as a stand-alone figure, not comparable with totals from previous whole-island counts of Buller's albatrosses since previous counts have not been corrected for has-egg rates. However, the corrected figure is the most accurate estimate we can obtain for the number of Buller's pairs breeding at the time of survey in March 2026.

Study colony nest numbers

Totals of 68, 42 and 106 nests with an egg or chick were counted in the Upper Punui Bay, Lower Punui Bay and Mollymawk Bay study colonies, respectively (Fig. 4). Included in these totals were three nests in Upper Punui Bay, two in Lower Punui Bay and three in Mollymawk each containing egg fragments indicating that the egg had been broken earlier in the breeding season. The 2026 totals represent slight decreases, relative to numbers counted in April 2025, of 1.5%, 8.7% and 5.4% in the Upper Punui Bay, Lower Punui Bay and Mollymawk Bay study colonies, respectively.

We also established a new, fourth, study colony at South Punui Bay. The breeding colony at South Punui contained 132 nests in 2023, but only 77 in 2026. Adding the South Punui colony brings the annually-monitored population to 3.6% of the whole (proportion of nests, 293 out of 8,194 in 2026).

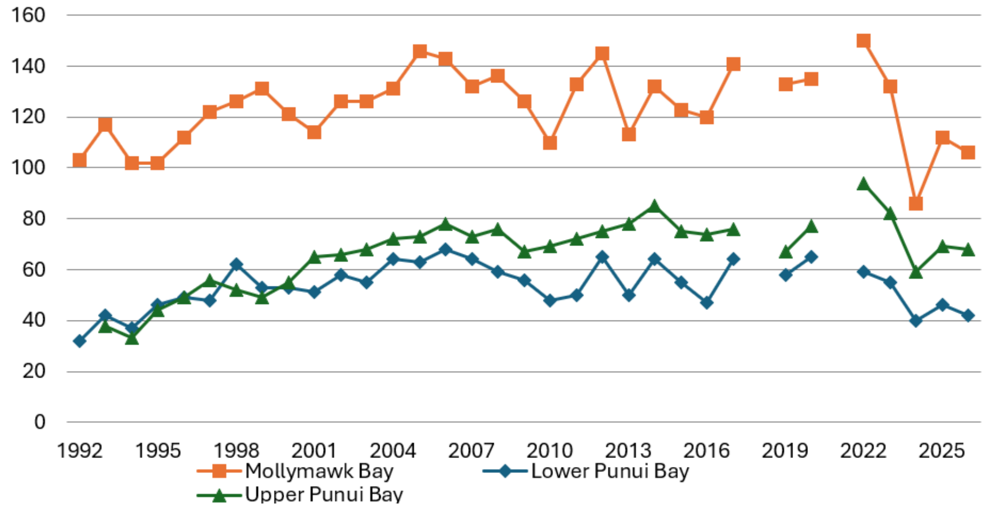

Figure 4. Numbers of breeding pairs of southern Buller's albatrosses counted annually at three study areas, Tini Heke | The Snares 1992–2026. No visits were made to the study colonies in 2018 and 2021, hence the gaps in the data.

Banding and resightings

A total of 422 birds that had been banded previously as breeding adults of unknown age in the study colonies were recaptured. This total comprises breeding birds, non-breeding birds, and failed breeders. In addition, a further 56 unbanded breeding birds (i.e., birds that were incubating) were banded within the study colonies. Because birds breeding in the study colonies have been checked annually since 1992 (with the exception of 2018 and 2021), we assumed that non-banded birds that are captured from their nests are first-time breeders, and so likely to have been 10–12 years old, the average age of first breeding (Francis & Sagar 2012). Furthermore, in the new South Punui study colony, 87 unbanded incubating adults were banded during Feb–Mar 2026. In addition, we recaptured 16 of the 216 birds that were banded as near-fledged chicks over the period 1992–2001 in South Punui Bay. Alphanumeric bands were added to 112 newly banded and recaptured birds as necessary.

At The Snares, breeding birds were banded during studies in 1948, 1961 and most years 1968–1977. No banded birds from these studies were recorded in 2026. Likewise, despite searches being made for birds banded as breeding adults of unknown age in the three study colonies, none were found away from the colony where they were banded, showing the strong fidelity to nesting sites.

Adult survival

A range of mark-recapture models for southern Buller's albatrosses were compared using AICc. The best supported model was one where both survival rate and resighting probability differ over time (model 1, Table 3); in other words, the model that best fit the data was one that explicitly accounts for the varied resighting effort and survival rates seen in the dataset over time. There was no support for survival being constant or survival differing by sex (models 2–4, Table 3). There was also no indication that resighting probability should be treated as a constant over time, or that it varies by sex (models lower-ranking therefore not shown).

Using the best-supported model to estimate annual survival rates—accounting for varying survival and resighting probabilities over time—annual survival was relatively high before 2012, with values varying around an average of 0.95 ± 0.01 (± 1 SE). Since 2012, point estimates have tended to decline, with average annual survival of 0.91 ± 0.02 (Table 4, Figure 5). The last five estimates over the period 2019 to 2025 have varied between 0.85 and 0.94 (Table 4). The most recent estimate of annual survival of birds banded as breeders was 0.85 ± 0.04.

Table 3. Model selection table for the top four models of southern Buller's albatross survival

Model		npar	AICc	ΔAICc
1.	Survival varies with time; resighting probability varies with time	64	24271.01	0.00
2.	Survival varies by time and sex; resighting probability varies with time	96	24311.92	40.90609
3.	Survival varies by sex and resighting probability varies with time	34	24478.33	207.31984
4.	Survival constant, resighting probability varies with time	33	24478.96	207.94951

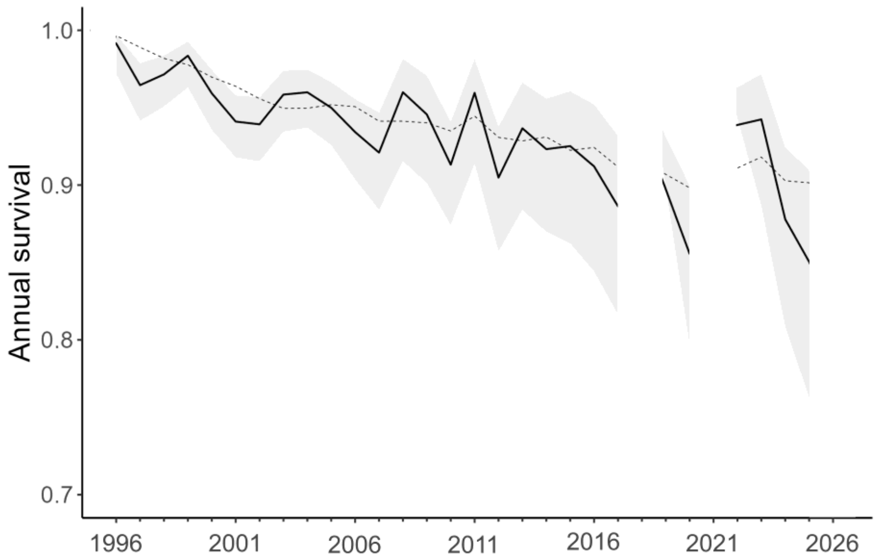

Figure 5. Estimated annual survival of southern Buller's albatrosses at The Snares. Survival estimates are the black lines; variance estimates (upper and lower 95% confidence intervals) are shaded areas; rolling averages of 4 years are the dashed line. Note: in this date convention, 1996 refers to the 1995–1996 breeding season. There were no research visits in 2018 and 2021. Mark-recapture estimates tend to be poor for the most recent year of data collection, and so the 2026 survival estimate is omitted

Table 4. Estimated annual survival, for southern Buller's albatross at The Snares, from field visits 1992–2026. Note: in this date convention, the 1993 estimate is that for the year 1992–1993. LCL and UCL are lower and upper 95% confidence intervals. There were no research visits in 2018 and 2021. There is no 2026 estimate since mark-recapture estimates for the most recent year of data are not accurate and precise enough to be useful.

Year	Survival estimate	Standard error	LCL	UCL
1993	0.995	0.005	0.962	0.999
1994	1.000	0.000	1.000	1.000
1995	1.000	0.000	1.000	1.000
1996	0.991	0.005	0.972	0.997
1997	0.965	0.009	0.942	0.979
1998	0.971	0.008	0.951	0.984
1999	0.984	0.007	0.963	0.993
2000	0.959	0.010	0.936	0.974
2001	0.941	0.010	0.918	0.958
2002	0.939	0.010	0.915	0.957
2003	0.958	0.010	0.935	0.974
2004	0.960	0.009	0.937	0.975
2005	0.950	0.010	0.926	0.966
2006	0.934	0.013	0.904	0.956
2007	0.921	0.016	0.884	0.947
2008	0.960	0.016	0.915	0.982
2009	0.946	0.017	0.901	0.971
2010	0.913	0.017	0.874	0.941
2011	0.960	0.016	0.914	0.982
2012	0.905	0.020	0.857	0.938
2013	0.937	0.020	0.884	0.966
2014	0.923	0.021	0.870	0.956
2015	0.925	0.024	0.862	0.961
2016	0.912	0.027	0.844	0.952
2017	0.886	0.029	0.816	0.932
2018				
2019	0.939	0.015	1.000	0.963
2020	0.856	0.026	0.796	0.900
2021				
2022	0.935	0.012	1.000	0.955
2023	0.942	0.021	0.886	0.972
2024	0.878	0.029	0.808	0.925
2025	0.850	0.037	0.763	0.910

Return rate and recruitment of known-age birds

The return rate of known-age southern Buller's albatrosses is the raw proportion of a cohort of chicks banded close to fledging that are subsequently recaptured. Of the 2,765 birds banded as chicks near fledging in the study colonies and adjacent colonies between 1992 and 2004, 128 (4.6%) were recaptured during Feb–Mar 2026. The oldest known-age birds recaptured in the three study colonies for the first time since they were banded were two from the 1998 cohort, and so were 28 years old. These birds were on nests 100–200 m from their natal colony in an area only visited during whole-island counts. This highlights the effort required to obtain reliable estimates of the survival of these known-age birds.

Of the 1,991 birds banded as chicks near fledging in the study colonies during the period 1992–2004 (which would now be at least 22 years old), 585 (29.4%) have been recaptured. The lowest rate of return (14.9%, 16 recaptured from 107 banded) is for the 2003 cohort in Punui Bay (Lower and Upper Punui Bay colonies combined) and the highest rate of return (44.3%, 27 recaptured from 61 banded) from the 1995 cohort in these same colonies (Table 5).

Recruitment—the number of birds breeding in the study areas for the first time—ranges from 14.1% in 2001 to 26.6% in 2004 (Fig. 6). A plot of recruitment rate, by cohort, of birds banded as chicks from 1992 to 2004 (Fig. 6) shows a slight decline during the period 1992 to 1997, followed by an increase 1998 to 1999 and then a slight decline 1998 to 2003, before a steep increase in 2004.

During 2013 and 2014, 40 and 82, respectively, fully-feathered fledglings were banded in the study colonies. To date, 10 (25%) of the 2013 cohort and 6 (7.3%) of the 2014 cohort have been recaptured.

Table 5. Number banded, number recruited to the breeding population and *% recruited of total banded in each cohort* (listed in order of top to bottom) of southern Buller's albatrosses that were banded as well-grown chicks in 1992–2004. Data are presented by colony of provenance, with Punui Bay colonies combined.

Colony/ cohort	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Mollymawk Bay	70 14 *20.0*	88 19 *21.6*	70 15 *21.4*	23 2 *8.7*	85 11 *12.9*	95 8 *8.4*	81 17 *21.0*	88 24 *27.3*	89 20 *22.5*	81 10 *12.3*	95 11 *11.6*	95 17 *17.9*	99 20 *20.2*
Punui Bay	46 15 *32.6*	58 9 *15.5*	43 10 *23.2*	61 11 *18.0*	65 16 *24.6*	75 19 *25.3*	77 17 *22.1*	51 11 *21.6*	84 15 *17.9*	82 13 *15.9*	94 22 *23.4*	107 14 *13.1*	89 29 *32.6*

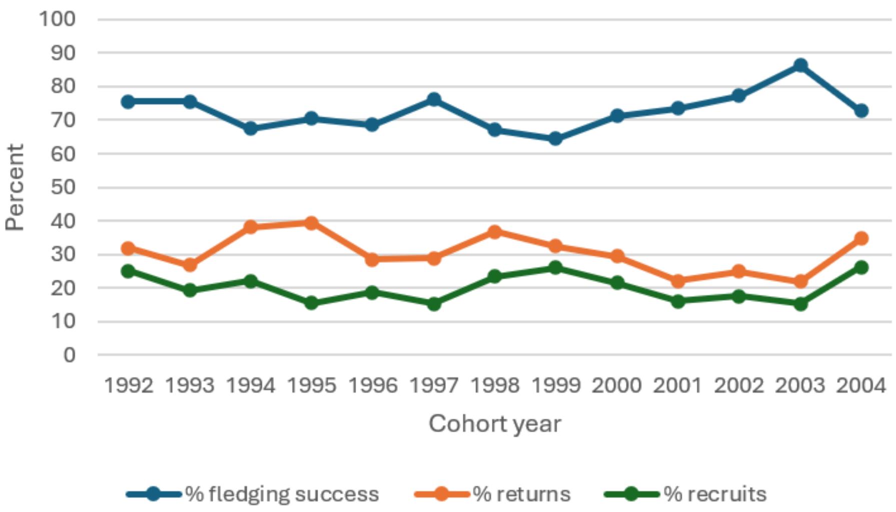

Figure 6. Fledging success and return and recruitment rates of southern Buller's albatrosses banded as well-grown chicks in three study colonies at The Snares, 1992–2004.

Some known-age birds, particularly females, will have settled to breed elsewhere on North East Island, beyond the annually-searched areas adjacent to the three study colonies (Sagar *et al.* 1998), and so the percentage returns and recruitment rates noted here should be considered as minima. Such birds may be detected during whole-island counts; for example, whole-island counts 1992–2020 found some of the 859 well-grown chicks that were banded across North East Island during August 1972 (Sagar *et al.* 1998), although none of these birds were recorded during Feb–Mar 2026..

Tracker deployment and retrieval

Of the long-term deployments to assess risk from fisheries and offshore wind farm development, 17 regular satellite tracking devices (Druid YAWL) were fitted successfully without the need for further intervention. However, four pressure-sensing satellite trackers were fitted on breeding birds, after which devices malfunctioned. Consequently, the remaining four pressure-sensing satellite trackers were not deployed. Of those four deployed, three could be removed for data recovery.

A further seven of the 26 GLS devices deployed on breeding birds during April 2024 were retrieved, along with five deployed with IgotU in 2024 and 2025 but not recovered at the time. Data from trackers are being analysed separately.

Of seven short-term deployments of device combinations recording foraging behaviour (five birds carrying GPS and TDR, two birds carrying TDR only), unfortunately only two were retrieved when birds returned from sea. Two birds did not go to sea, so their devices were removed. Three birds did not come back to the colony in time for their devices to be recovered (two carrying GPS-TDR, one with TDR only).

From the two TDRs recovered, we see that one bird did not dive (dives being >1 m underwater) over the days it was tracked. However, the other bird performed 52 dives during two days while it was off southern Tasmania, over the course of the eight days it was tracked. This bird provided the first dive statistics for this southern Buller's albatrosses (Table 6).

Table 6. Summary statistics of diving behaviour of a southern Buller's albatross from Tini Heke | Snares in March 2026

	Mean	SE	Min	Max
Descent rate (m/s)	1.00	0.05	0.40	1.80
Duration (s)	7.55	0.57	1.00	18.50
Depth (m)	3.06	0.17	1.09	5.56

Nest cameras

SD cards and batteries were replaced in 11 of last year's 17 nest cameras. Of these, two cameras had to be repositioned to capture nests in the field of view. Five cameras suffered major corrosion (battery leakage or water ingress) so were removed, and one could not be relocated among windfall. In total, eleven nest cameras remain on island to collect further nest-progress data. Data from the cameras are being analysed separately.

Lastly, ten sooty shearwater (*Ardenna grisea*) carcasses/wings were collected for an assessment of population connectivity (Manaaki Whenua Landcare Research and DOC).

Discussion

Whole-island count

Our best estimate for the number of pairs breeding in Mar 2026 is 8,194 pairs of southern Buller's albatrosses across Tini Heke | The Snares, correcting vantage point counts with a has-egg rate and estimating numbers nesting in unsurveyed areas. This should be taken as a stand-alone estimate, not comparable to previous counts (unless similar corrections were to be applied).

With varied count coverage, comparison of change over time is best made across areas counted in all years (that is, excluding areas not counted in some years for clearest comparability). We see that the population on North East Island increased markedly and more than doubled between 1969 and 2002 (4,024 versus 8,165 breeding pairs) (Sagar & Stahl 2005). Averaged annual rates of increase during this period were highest (3.4%) in 1969–1992, decreased between 1992 and 1997 (1.6%) and decreased further between 1997 and 2002 (1.1%). Comparison of the counts between 2002 and 2014 indicates a very slight decline of -0.12%/annum, which is well within the margin of error of the vantage point counts (Sagar 2014). However, the decline, over comparable areas, from 5,812 breeding pairs in 2014 to 5,289 in 2026 averages 0.75%/annum, which indicates a substantive change in the population. The trend in estimated numbers of breeding pairs on Broughton Island appears similar to that on North East Island over the period 1992–2014, but has remained more or less stable through to 2026.

The slow decline since the mid-2000s across the whole Snares group is also clear when all Snares survey data are standardised and robust trend models are applied. With adult survival continuing to be low (see discussion below), it is likely that declines will continue. The gradual decline at the Tini Heke | Snares breeding site contrasts with the increases seen at the other southern Buller's albatross breeding site (a small population on Hautere | Solander) and at the two northern Buller's albatross colonies in the Chatham Islands (Fischer *et al.* 2026). Buller's from the Chathams breed much earlier and forage in quite different areas than do Snares birds, two points of difference that likely influence population trajectories. For example, the Snares population forages more in the Tasman Sea high seas than do Buller's from the Chathams, so they may be more impacted by bycatch in pelagic longline fisheries there than are other populations (Fischer *et al.* 2023). Southern Buller's albatrosses from The Snares appear to largely co-occur with trawlers in NZ and Australian waters, more than do other populations (Rutter *et al.* 2026). This insight may suggest another cause of different population trajectories: underestimated mortalities due to unknown cryptic mortality (birds killed but not retained in the fishing gear), which is more of an issue on trawl gear, where dead birds keep sliding down a warp so are less likely to be brought aboard.

Study colonies

Information from the three Snares Islands study colonies overall suggests that the breeding population peaked during 2005–2006, then trended downward until 2010. Subsequently the breeding population has been variable in the Lower Punui Bay and Mollymawk Bay study colonies with marked annual increases and decreases, whilst numbers in the Upper Punui Bay colony have tended to increase in most years. The numbers of breeding pairs in all three study colonies in 2024 were substantially lower than those recorded in 2022 and 2023. While numbers of breeding pairs increased in all three study colonies in 2025, they remained lower than numbers 2022–23 and have not returned to the levels recorded before 2010 (Sagar *et al.* 2025). Thus, the trend in counts of breeding pairs in the study colonies has closely matched the trend in whole-island counts, indicating that study colonies remain representative of trends across the whole island population.

The trends in the numbers of pairs breeding in the study colonies until 2007 broadly reflect changes in annual adult survival (Sagar *et al.* 2000; Francis & Sagar 2012), with higher annual adult survival rates 1992–2004 (Sagar *et al.* 2000) followed by declines through to 2016 (Francis & Sagar 2012; Sagar *et al.* 2017). Therefore, it is not surprising that the substantial decline in the numbers of breeding pairs in all three study colonies since 2024 is matched by similarly low estimated survival rates for 2024 and 2025.

Since 2012 the annual recruitment rate (calculated from the numbers of newly banded birds and recaptures of known-age birds) increased from 10–11% to 16–21%, which led Sagar *et al.* (2017) to suggest that this is likely sustaining the breeding population and without it the population would decline. In 2026, 13.5% (56 of 414) of the total number of breeding birds recorded were newly banded or known-age birds breeding for the first time. Despite being lower than in some years, 13% recruitment remains relatively high if we consider a stable population to be one where the annual recruitment rate is similar to the annual mortality rate, with annual mortality rates in stable populations <8% (see Survival discussion below). Therefore, 13.5% recruitment is high, and points to a population being propped up by recruitment of birds without whom the breeding population would have declined substantially.

An additional factor leading to the still relatively low breeding numbers could be that reduced food availability during overwintering in the Humboldt Current resulted in adults not being in sufficient condition to breed and so taking a sabbatical year, therefore reducing their breeding frequency. Reduced food availability is also indicated by a later than expected end to the laying period. We suspected a later than usual start to the laying period in 2025 (Sagar *et al.* 2025), and in 2026 we recorded a later than expected end to the laying period, with 11 eggs being laid in the three study colonies between 27 Feb and 7 Mar. No eggs were laid in the Mollymawk Bay study colony later than 29 Feb during four seasons in the period 1969 to 1977 (Sagar & Warham 1998) and only one egg had been laid in March (3 Mar) in the previous 33 years of the current study. If there has been reduced natural food production—or changes in the distribution of prey—due to warmer seas (for example, during marine heatwaves in southern New Zealand, or in El Niño years in the Humboldt Current; Thatje *et al.* 2008; Behrens *et al.* 2025), then this may lead to greater attendance of southern Buller's albatrosses at fishing vessels and result in a greater likelihood of bycatch. Similarly, if fish species distribution changes, fishing vessels distribution will shift correspondingly, so vessels may overlap with birds in different areas.

Estimated annual survival

Substantial declines in the survival rate of southern Buller's albatrosses are an obvious consequence of the mortalities recorded on fishing gear (e.g., Peatman *et al.* 2019; Edwards *et al.* 2023) and will in turn be an important part of the decreases in breeding numbers documented here. Despite two recent survival estimates, for 2022 and 2023, being relatively high at around 0.94—approaching the survival rates more-commonly recorded before 2013—the longer-term decline in the estimated annual survival rates of birds banded as breeding adults is concerning. Substantial variability in survival rates is not unusual in albatrosses (e.g., Elliott *et al.* 2024), simply reflecting the spatial and temporal variability of fishing effort, such that bycatch some years occurs at higher rates. The issue is the ongoing decrease in survival: since 2011 annual survival has usually been below the accepted level (0.92) to maintain a stable population. In other albatross species, population numbers declined when survival rates were below 92%, with survival rates of 96–97% when population numbers were stable (Weimerskirch & Jouventin 1987; Cuthbert *et al.* 2004; Pardo *et al.* 2017). At 0.86 and 0.85, the estimates for 2020 and 2025 are the lowest recorded during the 33 years of the current study.

Return and recruitment rates

The return and recruitment rates of known-age birds banded 1992–2004 show considerable variation both within colonies between years and between colonies within the same year. Although future resighting work is likely to increase both return and recruitment rates for those cohorts, few new birds are likely to be recaptured. The first recaptures of two birds banded as chicks in 1998 are a result of the greater search area being covered during the whole-island count.

Recommendations

It is pleasing to note that some of the recommendations made by Sagar *et al.* (2024) have been actioned. The attachment of uniquely numbered alphanumeric bands during the January and April 2025 trips have already provided greater numbers of resightings on The Snares, with much less stress on both the field team and the birds. The longer trip in Feb–Mar 2026 enabled recaptures of a greater number of banded birds in the study colonies. Additionally, a three-year project to visit The Snares in Aug–Sept, starting in 2026, to record breeding success and band fledglings is planned per the 2025/26 CSP Annual Plan (CSP POP2025-01). Satellite tracking of fledglings is planned during these efforts as well.

We recommend:

- Extending annual counts for more-precise trend estimates. Annual counts of the number of breeding birds with an egg or chick in the area from the hut to the tip of North Prom will require an extra 1–2 days. The ~1,000 pairs in that area will increase the proportion of the total population counted annually, reducing the variance in annual trend assessments;
- Allowing for longer trips going forward, since recapture of a greater number of banded breeding and non-breeding birds in the study colonies improves the quality of key demographic parameter estimates; and
- Taking into account conditions for accessing the Razorback and South West Promontory on North East Island, determine the H&S procedures necessary prior to the next full island count of breeding Buller's albatrosses at Tini Heke | Snares.

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Appendix A: corrections for uncounted areas and vantage-point counts

Estimating albatross numbers in uncounted areas

To estimate the number of birds in uncounted areas in a given survey year, we use the rate of change in areas counted both years following the approach in Thompson & Sagar (2020). Specifically, we take the ratio of counts on maps where there are counts both this and last survey years (total counts including recent failures), and apply the mean ratio to the previous count for a map.

The ratio of counts conducted in both seasons 2019/20 and 2014 was 1.1015 (95% CI: 0.92–1.28) over the 18 maps counted in full in both years (Table A1). Therefore, maps uncounted in 2019/20 (maps 11–18, Fig. 2) have nest numbers estimated by multiplying the 2014 count by 1.1015 (bold purple figures, Table A1). Similarly, the ratio across maps counted in both 2026 and 2019/20 was 1.0096 (0.71–1.31, 19 maps counted in full in both years), so this ratio is applied to uncounted areas in 2026 to estimate nest numbers there (maps 11–16) (Table A1). Finally, Broughton was not counted in 2002, so the 1992 count is multiplied by the rate of change on NE Island 1997/1992 (1.0571), following (Thompson & Sagar 2020).

This provides an estimate of the number of birds likely to have been present across the entirety of the Snares in a given season, provided the direction of change follows that in maps counted both years.

Table A1. Estimates of nest numbers in uncounted maps (***bold italic purple***) using the mean rate of change in counts of the number of occupied nests in count maps on the Snares Islands. Estimates for 2019/20 are the 2014 count for a map, multiplied by 1.1015. For 2026, the 2019/20 count is multiplied by 1.0096. The 2002 estimate for Broughton is the 1992 count multiplied by 1.0571. Calculated rates of change for each map/period are italicised

Map #	1969	1992	1997	2002	2014 total	2019/20 total	*Rate of change 20/14*	2026 total	*Rate of change 26/20*
1	9	19	26	32	37	47	*1.27027*	41	*0.87234*
2	24	83	117	127	100	90	*0.9*	83	*0.92222*
3	138	296	359	453	575	504	*0.87652*	421	*0.83532*
4	75	246	312	288	368	502	*1.36413*	329	*0.65538*
5	154	225	350	477	281	253	*0.90036*	485	*1.917*
6	28	23	48	63	38	63	*1.65789*	32	*0.50794*
7	52	165	131	143	109	145	*1.33028*	120	*0.82759*
8	29	51	57	60	91	154	*1.69231*	25	*0.16234*
9	39	87	62	46	55	87	*1.58182*	58	*0.66667*
10	82	175	255	109	91	106	*1.16484*	84	*0.79245*
11	131	391	263	330	283	***312***		***315***	
12	121	282	187	205	215	***237***		***239***	
13	200	418	433	372	274	***302***		***305***	
14	3	75	65	65	51	***56***		***57***	
15	112	193	223	267	305	***336***		***339***	

16	451	587	768	638	624	***687***		***694***	
17	162	268	214	204	392	***432***		594	*1.37566*
18	587	1211	1039	1402	929	***1023***		1007	*0.98407*
19	394	309	480	453	668	633	*0.9476*	392	*0.61927*
20	192	243	244	245	277	152	*0.54874*	310	*2.03947*
21	188	298	381	328	361	375	*1.03878*	411	*1.096*
22	206	266	231	317	278	307	*1.10432*	222	*0.72313*
23	312	516	605	654	659	671	*1.01821*	373	*0.55589*
24	75	66	128	121	228	113	*0.49561*	290	*2.56637*
25	241	629	707	750	713	572	*0.80224*	608	*1.06294*
26	19	22	39	16	45	51	*1.13333*	***51***	
Total NE Isl	4024	7144	7724	8165	8047	8210		7885	
Total Broughton	***424***	539	518	***548***	657	621		680	
Totals all	4448	7683	8242	8713	8704	8831		8565	

Nest contents correction for vantage-point counts

Vantage-point counts are less accurate than ground counts of nests with known contents, since it is not possible to determine via binoculars whether apparently nesting albatrosses (ANA) have an egg in the nest cup. The proportion of ANA actually sitting on an egg—or has-egg rate—is highly variable in albatrosses (e.g., Rexer-Huber *et al.* 2025), including from day to day, so checks of nests for eggs should ideally be concurrent with the vantage point count.

As described above, ground counts record numbers of birds incubating an intact egg. To enable a has-egg correction, we also noted whether birds appeared to be incubating as we approached (ANA), and recorded the number that turned out not to have an egg. These extra data were collected during a proportion of ground counts in colonies directly above the cliff-bound birds that were vantage-counted with binoculars. The has-egg rate is calculated as bird on egg/ANA, and the number of nesting birds with eggs in vantage-point counts calculated as the vantage-point count multiplied by the has-egg rate for that day/area. Where nest-contents data could not be collected from the colony above, we either apply the average has-egg rate (0.8098, LCL–UCL 0.7663–0.8533, across all 9 day/areas checked), or apply the has-egg rate recorded that day in a different spatial area (Table A2).

To estimate the total breeding pairs present in each count map at the time of survey in March 2026, we take the known number of nests with eggs (ground count total) and add the estimate for vantage-point areas (scan count corrected with has-egg rate). Estimates for each count map (including one for Broughton Island) are summed to get a total estimate of the number of breeding pairs of Bullers albatrosses present on Snares in March 2026.

The has-egg rate ranged widely from 70% to 90% across the nine distinct days and areas checked (median sample size 410 nests, from a total of 3,094 nests checked) (Table A2), highlighting the importance of nest-contents checks being concurrent with nearby vantage-point counts to keep estimated nesting numbers as accurate as possible.

Table A2. Nest contents of apparently-nesting southern Buller's albatross in 2026. Has-egg rate is bird on egg/ANA.

Date	Bird on egg	Bird on empty nest	ANA (apparently nesting albatross)	Has-egg rate	SE has-egg rate
7/03/2026	343	67	410	0.8366	0.0217
8/03/2026	459	117	576	0.8072	0.0168
10/03/2026	248	60	308	0.7899	0.0228
11/03/2026	461	98	559	0.8062	0.0295
13/03/2026	19	6	25	0.7024	0.0535
17/03/2026	281	47	328	0.8567	0.0281
17/03/2026	511	101	612	0.8393	0.0102
20/03/2026	411	108	519	0.7498	0.0449
21/03/2026	36	4	40	0.900	