



**NIWA**  
Taihoro Nukurangi

# Population studies of southern Buller's albatrosses on the Snares Islands | Tine Heke

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## Executive summary

This report presents a summary of the results of counts of southern Buller's albatrosses *Thalassarche bulleri bulleri* breeding at the Snares Islands|Tine Heke from 11-17 March 2020 and compares these results with those obtained using similar methods during 1969, 1992, 1997, 2002, 2014 and 2019. In addition, the results of detailed demographic studies at three study colonies are presented.

The count used similar methods, and was completed at a similar time of year, to previous counts completed during 1969, 1992, 1997, 2002 and 2014. The current survey of North East Island was incomplete due to adverse weather. However, the total of 5164 breeding pairs recorded along the East Coast, North Promontory, South Coast and West Coast was very similar to the 5305 breeding pairs estimated in the same areas in 2014. This result indicates that the increase in size of the breeding population over the period 1969-2002 has not continued. An additional 621 breeding pairs were estimated on Broughton Island in 2019.

Demographic studies at the three study colonies on North East Island have been undertaken annually 1992-2017, and so this report incorporates some of these data in the current analysis. Estimates of the numbers of breeding pairs, made by recording the contents of each nest mound, increased in all three colonies over the numbers recorded during 2019. With the assumption that the combined total number of breeding pairs in the three study colonies was representative of North East Island as a whole then the breeding population probably peaked in 2005-2006 and has since undergone marked annual variations.

A total of 245 birds previously banded in the study colonies as breeding adults of unknown age were recaptured. A further 77 breeding birds were banded in the study colonies - these are presumed to be first-time breeders. Estimates of annual survival of birds banded as breeders continued to decline, with an estimate of 0.889 in 2017. During the period 1992-2004 all chicks that survived to near-fledging in the study colonies were banded and survival rates monitored via return to the study colonies in subsequent years. This year 125 of these birds were recaptured, with birds from cohorts banded between 1999-2004 being recaptured for the first time. This demonstrates the long-term monitoring required to obtain reliable estimates of survival of such known-age birds. Of these 162 known-age birds recaptured, 13 were found breeding for the first time, and so were recorded as being recruited to the breeding population. A bird banded as a chick on Big Solander Island in 2002 was recaptured on an empty nest. One bird banded as a chick in 1972, was recaptured at 48 years of age.

Fifty Global Location Sensing (GLS) tags were attached to the metal leg bands of breeding birds in the Mollymawk Bay study colony; these will be retrieved during 2021 and 2022. A GPS device was used to record latitude and longitude coordinates at waypoints around the perimeter of each of the three study colonies, and trail cameras will be installed in 2021 at nest sites determined from this years study.

# 1 Background

This project was funded by the Conservation Services Programme, Department of Conservation (CSP, DOC). The purpose of the project was to complete a whole-island survey of the Snares Islands | Tine Heke for breeding southern Buller's albatrosses *Thalassarche bulleri bulleri*, with limited checks of study colonies. The specific objectives of the project were to:

1. Complete a whole-island count of breeding southern Buller's albatrosses at the Snares Islands, covering those areas not surveyed in 2019.
2. Establish the numbers of pairs breeding in the three established study colonies.
3. Determine the numbers of breeding pairs in other well-defined locations, and so correct whole island counts made in 2019 and 2020.
4. Establish annual survival of banded birds from recapture data.
5. Deploy 50 Global Location Sensing (GLS) tags on birds in the study colonies.
6. Using a hand-held Global Positioning System (GPS) device, determine the boundaries of the three study colonies.
7. Assess likely locations in the study colonies for the deployment of trail cameras.

This report describes the field work completed at the Snares Islands under DOC contract POP2019-04 in accordance with Wildlife Act Authority 52364-FAU and Management Tracking Document DOC 6227162.

Fieldwork centered on completing an accurate estimate of the numbers of pairs of southern Buller's albatrosses breeding on North East Island, initiated in 2019, for comparison with similar counts completed in 1969, 1992, 1997, 2002 and 2014. In addition, further information was obtained regarding the population dynamics of southern Buller's albatross, particularly population size, adult survival, breeding frequency, and recruitment of known-age birds in three long-term study colonies. Demographic data of southern Buller's albatrosses in these study colonies at the Snares Islands were recorded annually 1992-2017 and in 2019.

## 2 Methods

### 2.1 Logistics

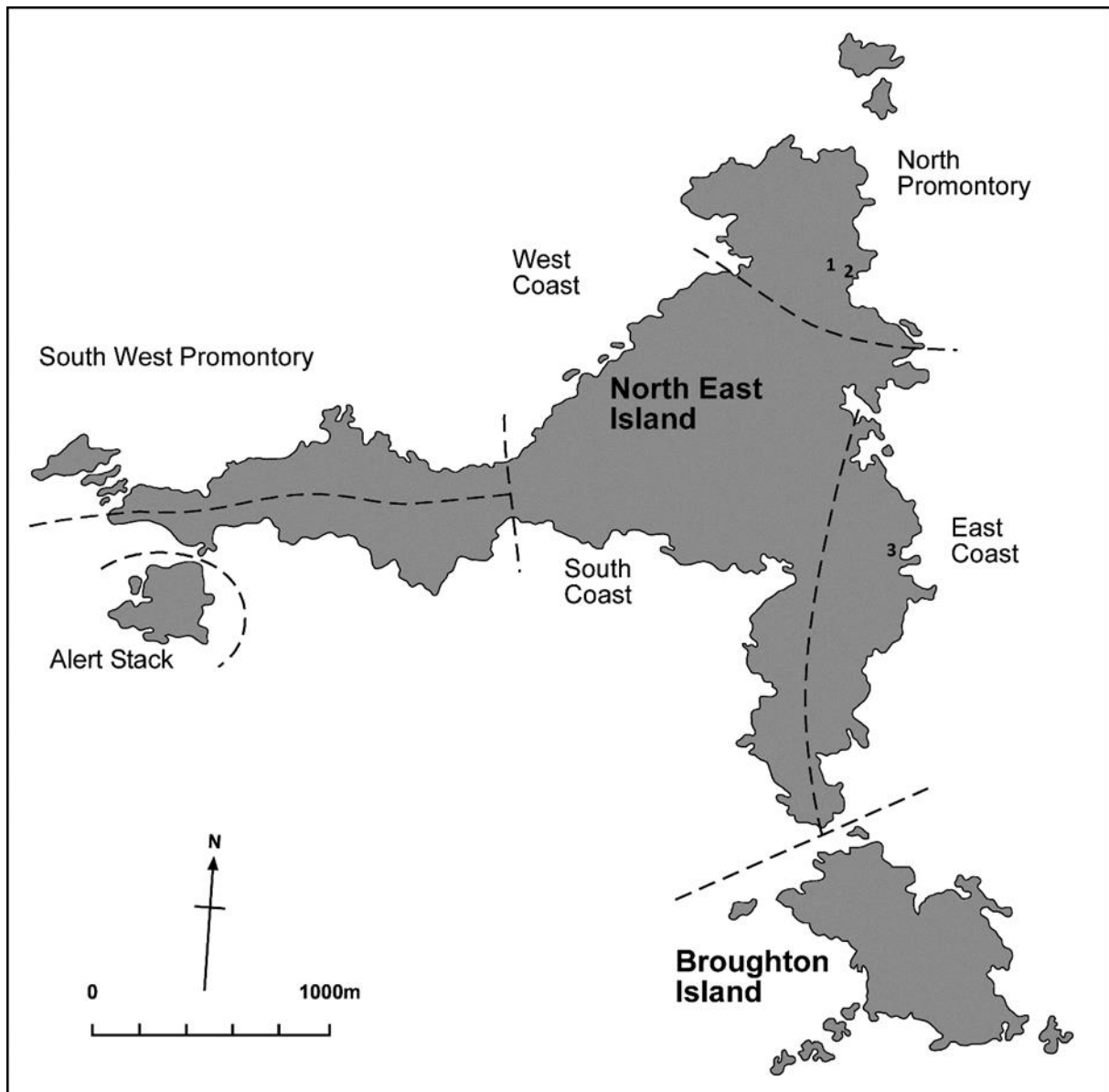
Transport to and from the Snares Islands was provided by the vessel *Awesome* (skipper, plus four crew). The field team (comprising David Thompson (field leader, NIWA), Paul Sagar (NIWA) and David Sagar (DOC)) were dropped off at Boat Harbour, North East Island at 08:00 on 11 March 2020. *Awesome* picked up the party from Boat Harbour at 18:00 on 17 March 2020 and returned them to Bluff early the following morning.

### 2.2 Whole-island counts

The Snares Islands (48°01'S, 166°36'E) comprise North East Island (280 ha) and Broughton Island (90 ha), plus numerous islets and stacks (Figure 2-1). The laying period of southern Buller's albatrosses at The Snares extends from late December to the end of February, with most eggs laid by late January (Sagar & Warham 1998). Therefore, in 2019 the timing of counts was scheduled to occur close to the end of laying, when most birds sitting on a nest were presumed to be incubating. The counts of incubating birds on North East Island and adjacent main islets and stacks were completed 2-10 March 2019, with the count on Broughton Island completed on 1 March 2019. However, due to a prolonged period of adverse weather the count on North East Island was incomplete, with no parts of the South Coast and the South West Promontory surveyed (see Figure 2-1 for locations of specific areas). Therefore, the primary aim of the 2020 trip was to complete the count of breeding birds in these areas.

When counting incubating birds we followed the procedure used in 1992, 1997, 2002 and 2014, which was similar to that used in 1969 (Warham & Bennington 1983; Sagar et al. 1994, 1999; Sagar & Stahl 2005). The islands were divided into sections, based on maps prepared from aerial photographs and each section was covered systematically in a search for breeding albatrosses.

On North East Island, ground counts were completed wherever access to nests was possible. In such situations usually one person used a tally counter to keep a running total of nests counted with the other members of the field team calling out nests as they were checked. Included in ground counts were birds incubating an intact egg (assumed to be all birds sitting tightly on a nest mound), and nests with an abandoned or broken egg, or an egg that had rolled out of the nest. Abandoned, broken and eggs rolled out of the nest were assumed to represent pairs of albatrosses that had attempted to breed that season, hence their inclusion in the total count. Birds breeding in inaccessible areas were counted from vantage points, at distances up to 500 m, using binoculars. In the majority of such situations counts were made by all three observers independently, and averaged. Where vantage-point counts of >100 occupied nests occurred, the total counted by each observer had to be within 10% of the average. Where the average was < 100 occupied nests, the totals had to be within 5%. For both ground and vantage-point counts, birds standing on nest mounds (which were thus assumed to be empty) were not included in the totals. Abandoned and broken eggs could not be counted from vantage-point counts, and so totals from these counts were considered to represent the minimum number of breeding pairs.



**Figure 2-1: The Snares Islands, showing the boundaries of areas where counts of occupied nests of southern Buller's albatrosses were made.** Locations of study colonies are: 1, Upper Punui Bay; 2, Lower Punui Bay; 3, Mollymawk Bay.

To account for changes in the numbers of breeding pairs between years and the slightly later timing of the 2020 trip we also undertook counts of breeding birds in the three long-term study colonies and two other well-defined areas.

### 2.3 Study colonies

Each of three study colonies (Mollymawk Bay, Lower Punui Bay and Upper Punui Bay) on North East Island were visited 2-3 times; Upper Punui Bay and Lower Punui Bay on 11, 14 and 17 March 2020, and Mollymawk Bay on 12 and 15 March 2020. On the first visit to each colony, all nests were inspected, and the contents recorded. Band numbers of all adult birds associated with these nests were recorded and any unbanded birds incubating were captured and fitted with a uniquely numbered stainless steel leg band. All adult birds recorded on this first visit were marked with blue raddle (a temporary stock marker) so that they were not recaptured on the subsequent visit. On the



second visit to each colony, all nests were checked again, and any birds not marked with raddle were captured and band numbers recorded, or leg bands applied, as appropriate. In addition, on each visit an attempt was made to recapture as many as possible of the banded non-breeding birds that were loafing in the colonies.

GLS devices were deployed on 50 breeding birds in the Mollymawk Bay study colony on 15 March 2020. Each of these was attached by a single stainless-steel cored cable tie to the metal band.

## 2.4 Banded birds outside study colonies

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

## 2.5 Survival estimation

Survival was estimated from banded birds, using the mark-recapture programme Mark 9.0 (White & Burnham 1999) and a relatively simple Cormack-Jolly-Seber model. The model was run using data from 1992 to 2020, noting that 1993 was the first year for which a survival estimate was calculated. Estimates from 2017 to 2020 have not been presented in this report due to relatively large error estimates. Overall, this data set comprised 1546 birds banded across all years (1992-2020).

## 3 Results

### 3.1 Whole-island counts

A comparison of counts at five well-defined colonies showed an overall increase of 9.4% (413 vs 452) in 2020 over those counted in 2019 (Table 3-1).

**Table 3-1: Counts and percentage change in the number of breeding pairs of southern Buller's albatrosses at five well-defined colonies on the Snares Islands, 2019 and 2020.**

Colony location	2019	2020	% change
Mollymawk Bay	133	135	+1.5
Lower Punui Bay	58	65	+12.1
Upper Punui Bay	68	77	+13.2
South Punui Bay	52	60	+15.4
Razorback	102	115	+12.7

Therefore, a correction factor of 0.914 was applied to counts made in 2020 as an approximation of the number of breeding pairs of southern Buller's albatross likely to have been present in 2019.

Unfortunately, adverse weather (strong winds and rain) again prevented safe access to the South West Promontory and the adjacent area of the South Coast (Figure 2-1), the area most exposed to the prevailing weather, and so there was insufficient time to cover this area of North East Island.

With the addition of the adjusted counts for 2020 an estimated total of 5178 occupied nests (assumed to equate to breeding pairs) was counted on North East Island, with a further 621 counted on Broughton Island, for a combined estimate of 5799 occupied nests (Table 3-2). The estimate of 5178 in 2019-20 for North East Island compares to totals of 2574, 3898, 4718, 4980 and 5305 for the same areas covered in 1969, 1992, 1997, 2002 and 2014, respectively (Table 3-2). Totals for Broughton Island 1992-2014 show relatively little change (Table 3-2).

**Table 3-2: Numbers of occupied nests of southern Buller's albatrosses counted in different areas of the Snares Islands, 1969-2020.** Values in parentheses assume rates of change on Broughton Island in 1969 and 2002, when no counts (NC) were made, are equal to those in the subtotal for North East Island in those years. \*, incomplete count completed in 2020 and adjusted by multiplying by 0.914. #, North East Island totals for just those areas counted in 2019 and 2020. Data for 1969-2002 are from Sagar & Stahl (2005) and 2014 are from Sagar (2014).

Area/Year	1969	1992	1997	2002	2014	2019
North Promontory	509	1108	1400	1643	1508	1758
West Coast	121	262	317	205	146	193
North side, South-West Promontory	305	785	520	739	427	NC
South side, South-West Promontory	763	1236	1410	1025	1201	NC
Alert Stack	112	193	223	267	305	NC
South Coast	1425	2095	2161	2554	2425	1562*
East Coast	789	1465	1693	1732	1733	1665
<b>Total North East Island + Alert Stack</b>	<b>4024</b>	<b>7144</b>	<b>7724</b>	<b>8165</b>	<b>8047</b>	<b>5178</b>
<b>Total North East Island#</b>	<b>2574</b>	<b>3898</b>	<b>4718</b>	<b>4980</b>	<b>5305</b>	<b>5178</b>
Broughton Island	NC	539	518	NC	657	621
<b>Totals</b>	<b>(4448)</b>	<b>7683</b>	<b>8242</b>	<b>(8713)</b>	<b>8704</b>	<b>5799</b>

Considering the ground-count and vantage-point totals made 1992-2014 (Table 3-3), ground-count totals increased over time, whereas the vantage-point totals remained similar from 1992 to 2002, but decreased by 2014 (Table 3-3). For 2019-2020, the adjusted totals for North East Island comprised 3834 from ground counts and 1344 from vantage-point counts.

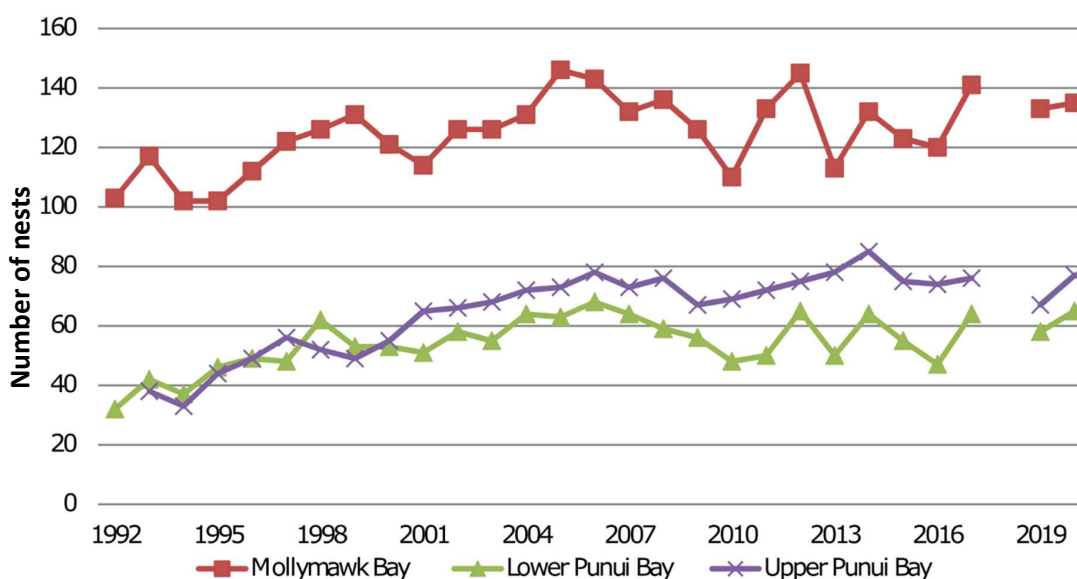
**Table 3-3: Counts and % of total (in parentheses) of occupied nests of southern Buller's albatrosses on the Snares Islands.** Ground counts and vantage-point counts, North East Island and Alert Stack on the Snares Islands. \*, partial count only.

Year	Ground-count total	Vantage-point total	Whole-island total
1992	3779 (53%)	3365 (47%)	7144
1997	4332 (56%)	3392 (44%)	7724
2002	4855 (59%)	3310 (41%)	8165
2014	4971 (62%)	3076 (38%)	8047
2019 & 2020*	3834 (74%)	1344 (26%)	5178

## 3.2 Study colonies

### 3.2.1 Number of occupied nests

Totals of 135, 65 and 77 nests with an egg were counted in the Mollymawk Bay, Lower Punui Bay and Upper Punui Bay study colonies, respectively (Figure 3-1). Included in these totals were three nests in Mollymawk Bay each containing egg fragments indicating an egg that had been laid but broken earlier that season. In Lower Punui Bay one nest contained an abandoned egg and another had the remains of a broken egg and at Upper Punui Bay two nests contained the remains of a broken egg.



**Figure 3-1: Numbers of breeding pairs of southern Buller's albatrosses counted annually at three study colonies on the Snares Islands 1992-2020.** No check was made of the study colonies in 2018, hence the gap in the data.

The 2020 totals represent increases, relative to numbers counted in March 2019, in the Mollymawk Bay, Lower Punui Bay and Upper Punui Bay of 1.5%, 12.1% and 13.2%, respectively.

### 3.2.2 Adult survival

A total of 245 birds that had been banded previously as breeding adults of unknown age were recaptured. This total comprised breeding birds, non-breeding birds, and failed breeders. In addition, a further 77 breeding birds (i.e., birds that were incubating) were banded within the study colonies.

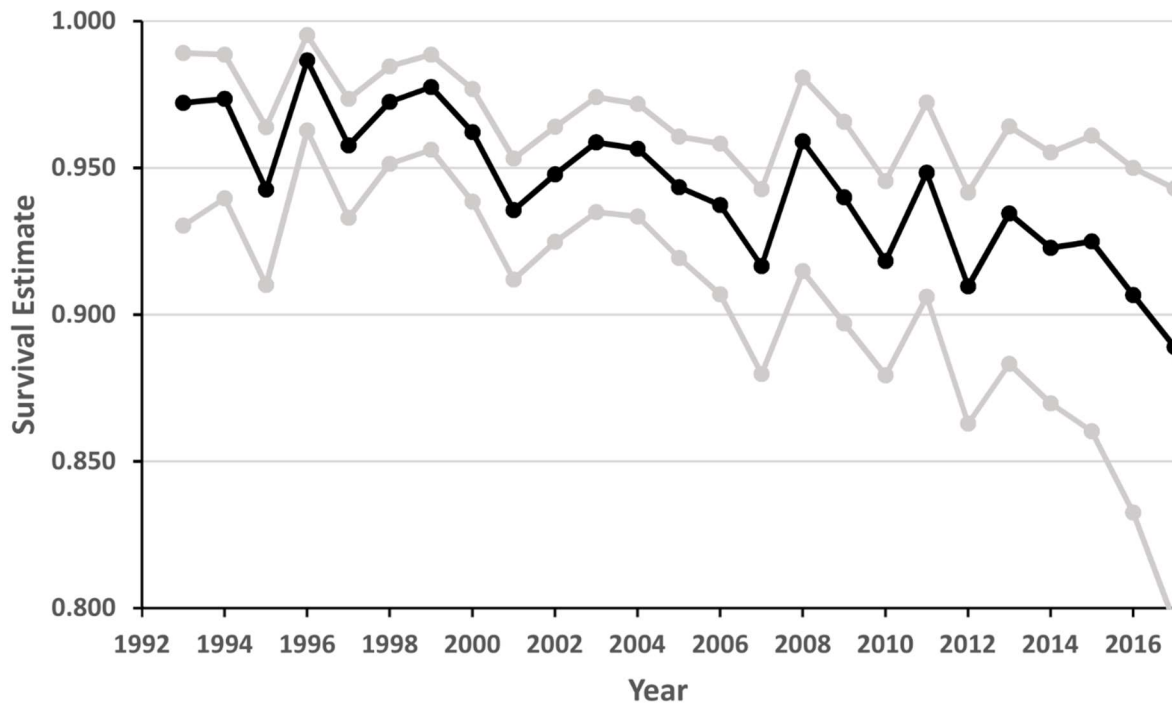
Because birds breeding in the study colonies have been checked annually, and any new birds banded since 1992, we assumed that any birds captured that are not banded are first-time breeders, and so likely to be 10-12 years old, the average age of first breeding (Francis & Sagar 2012).

All banding data (newly banded birds plus recaptures) have been submitted to the Banding Office, Department of Conservation, Wellington.

Estimates of annual survival are presented in Table 3-4 and plotted in Figure 3-2. Annual survival was relatively high prior to 2005, with values generally in excess of 0.95, from which point estimates tended to decline and were generally less than 0.95 through to 2017 (Table 3-4, Figure 3-2).

**Table 3-4: Estimates of annual survival, with 95% confidence intervals, for southern Buller's albatross at the Snares Islands, 1993 to 2017.**

Year	Survival Estimate	95% Conf Interval	
		Lower	Upper
1993	0.972	0.930	0.989
1994	0.973	0.940	0.989
1995	0.943	0.910	0.964
1996	0.987	0.963	0.995
1997	0.958	0.933	0.974
1998	0.972	0.951	0.985
1999	0.978	0.956	0.989
2000	0.962	0.938	0.977
2001	0.936	0.912	0.953
2002	0.948	0.925	0.964
2003	0.959	0.935	0.974
2004	0.956	0.933	0.972
2005	0.943	0.919	0.961
2006	0.937	0.907	0.958
2007	0.917	0.880	0.943
2008	0.959	0.915	0.981
2009	0.940	0.897	0.966
2010	0.918	0.879	0.945
2011	0.948	0.906	0.972
2012	0.910	0.863	0.942
2013	0.934	0.883	0.964
2014	0.923	0.870	0.955
2015	0.925	0.860	0.961
2016	0.907	0.833	0.950
2017	0.889	0.795	0.943



**Figure 3-2: Plots of estimated annual survival and upper and lower 95% CIs for southern Buller's albatross at the Snares Islands.** Survival estimates are shown by black dots, joined by a black line, with upper and lower 95% CIs shown by grey dots, joined by grey lines. Estimates are shown for the years 1993 to 2017, based on data spanning 1992 to 2020.

### 3.2.3 Survival and recruitment of known-age birds

Return rate of known-age birds:

The return rate of known-age southern Buller's albatrosses is the proportion of a cohort of chicks that is recaptured several years after banding. Of the 2765 birds banded as chicks near fledging in the study colonies and adjacent colonies between 1992 and 2004, 125 were recaptured during March 2020. These birds were from cohorts banded between 1992 and 2004. The oldest known-age birds recaptured in the three study colonies for the first time were from the 1999 cohort, and so were 21 years old. This indicates that many more years of recapture effort are required to obtain reliable estimates of the survival of these known-age birds.

Of the 1991 birds banded as chicks near fledging in the study colonies during the period 1992-2004 (which would now be at least 16 years old), 571 (28.6%) have been recaptured. The lowest rate of return (13.1%, 14 recaptured from 107 banded) is for the 2003 cohort in Punui Bay (Lower and Upper Punui Bay study colonies combined) and the highest rate of return (44.3%, 27 recaptured from 61 banded) from the 1995 cohort in these same colonies (Table 3-5).

**Table 3-5: Number (% of total banded) of southern Buller's albatrosses, banded as well-grown chicks in 1992-2004, returning to the Snares Islands.** Data are presented by colony of provenance, with Punui Bay colonies combined.

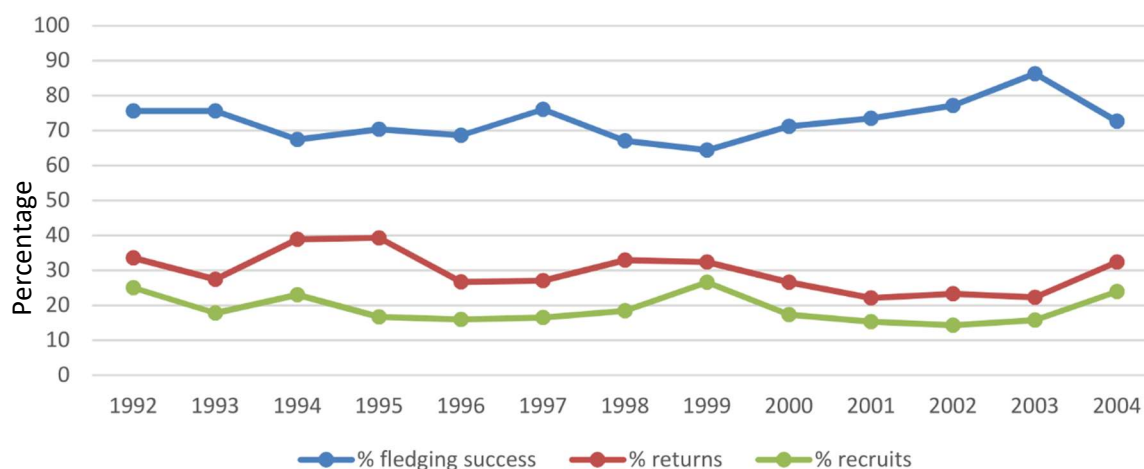
Colony/ cohort	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Mollymawk	19	28	26	6	19	20	32	34	25	17	22	31	28
Bay	(27.1)	(31.8)	(37.1)	(26.1)	(22.4)	(21.0)	(39.5)	(38.6)	(28.1)	(21.0)	(23.2)	(32.6)	(28.3)
Punui Bay	20	12	18	27	21	26	20	11	21	19	22	14	33
	(43.5)	(20.7)	(41.9)	(44.3)	(32.3)	(34.7)	(26.0)	(21.6)	(25.0)	(23.2)	(23.4)	(13.1)	(37.1)

With no new birds recaptured in the three study colonies during March 2020 from the 1992 to 1998 cohorts banded it is unlikely that any further birds from these cohorts will be recorded. A plot of the overall return rate (all three study colonies combined; Figure 3-3), shows that from these cohorts the percentage of banded known-age birds returning varied from 26.7% (1996 cohorts) to 39.3% (1995 cohort) for the cohorts banded 1992 to 1999. Currently, the return rate of cohorts banded 2000-2004 varies from 22.1% (2001 cohort) to 32.4% (2004 cohort) indicating that more birds from these cohorts have yet to be recaptured.

In addition, of the 40 birds banded as chicks near fledging in the study colonies during September 2013, one was recaptured; the first bird from this cohort to be recaptured back on the island. Also, a bird banded as a chick on Solander Island in July 2002 was recaptured on an empty nest in the Mollymawk Bay study colony.

Recruitment of known-age birds:

The recruitment rate of known-age southern Buller's albatrosses is the proportion of a cohort of chicks that is recaptured as breeding adults several years after banding: the recruitment rate is invariably less than the return rate because of mortality in the years between returning and the first breeding attempt.



**Figure 3-3: Fledging success and return and recruitment rates of southern Buller's albatrosses banded as chicks in three study colonies at the Snares Islands, 1992-2004.**

In March 2020, 13 known-age birds, banded as chicks in the study colonies 1992-2004, were found breeding for the first time i.e., they had recruited to the breeding population. Of these, seven were aged 16 years (banded as chicks in 2004), two were aged 17 years (banded as chicks in 2003), one was aged 18 years (banded as a chick in 2002), one was aged 19 years (banded as a chick in 2001), and two were aged 21 years (banded as chicks in 1999).

A plot of recruitment rate, by cohort, of birds banded as chicks 1992-2004 (Figure 3-3) shows an apparent decline throughout most of this period. However, given that the mean age of first breeding of southern Buller's albatrosses at the Snares Islands is 10-12 years (Francis & Sagar 2012) more birds from the later cohorts are likely to be recorded breeding in future. Therefore, it is probably prudent to estimate recruitment only for the 1992-1999 cohorts i.e., birds aged 20-27 years. Currently, these range from 8.7% for the 1995 cohort from Mollymawk Bay to 30.4% for the 1992 cohort from Punui Bay (Table 3-6). In addition, there is considerable variation in the recruitment rate both between years and between colonies in the same year (Table 3-6).

**Table 3-6: Numbers (% of total banded) of known-age southern Buller's albatross recruits (i.e. returning to breed) on the Snares Islands.** For cohorts banded in 1992-1999, by colony of provenance and with Punui Bay colonies combined.

Colony/cohort	1992	1993	1994	1995	1996	1997	1998	1999
Mollymawk Bay	15 (21.4)	18 (20.5)	15 (21.4)	2 (8.7)	10 (11.8)	8 (8.4)	14 (17.3)	27 (30.7)
Punui Bay	14 (30.4)	8 (13.4)	11 (25.6)	12 (19.7)	14 (21.5)	20 (26.7)	15 (19.5)	10 (19.6)

A plot of the overall recruitment rate (all three study colonies combined; Figure 3-3), shows that the percentage of banded known-age birds from the 1992 to 1999 cohorts that returned and survived to breed varied from 16.0% (1996 cohort) to 25.2% (1999 cohort). Currently, the recruitment rate of known-age birds banded between 2000-2004 varies from 13.8% (2002 cohort) to 23.9% (2004 cohort), with more birds likely to be recorded from these cohorts in future.

Despite searches for banded birds being made in other colonies adjacent to the three study colonies, some birds, particularly females, will have settled to breed elsewhere on North East Island (Sagar et al. 1998), and so the percentage returns from each cohort should be considered as a minimum.

At the Snares Islands, breeding birds were banded during studies in 1948, 1961 and most years between 1967-1977. None of these birds was recorded during March 2020. In addition, 859 well-grown chicks were banded at a large number of colonies distributed over much of North East Island during August 1972 (Sagar et al. 1998). One of these birds was recorded on an empty nest during March 2020. At 48 years, this is the oldest known-age southern Buller's albatrosses.

All recapture data have been submitted to the Banding Office, Department of Conservation, Wellington.

### 3.2.4 GLS deployment

GLS tags were attached to the metal band of 50 birds breeding in the Mollymawk Bay study colony on 15 March 2020. Of these, 32 were banded as adults of unknown age between 1992-2020 and 18 were banded as chicks between 1994-2004. From measurements of these birds it was estimated that 29 were male, 11 were female and 10 could not be assigned with confidence. Three of the birds had been tracked during a previous deployment of GLS tags in 2008-2010.

All details of the GLS tag deployment have been submitted to the Banding Office, Department of Conservation, Wellington.

### 3.3 Boundaries of the three study colonies

A hand-held GPS device (Garmin GPSmap 62s) was used to record latitude and longitude coordinates at waypoints around the perimeter of each of the three study colonies. For each study colony, perimeter waypoints are given as latitude south followed by longitude east, in degrees (ddd), minutes (mm) and seconds (ss.s) format.

For Lower Punui Bay (LPB):

LPB1	48°01'07.2"	166°36'23.8"
LPB2	48°01'07.0"	166°36'25.3"
LPB3	48°01'05.9"	166°36'25.1"
LPB4	48°01'06.4"	166°36'23.6"

For Upper Punui Bay (UPB):

UPB1	48°01'06.3"	166°36'22.3"
UPB2	48°01'06.1"	166°36'22.4"
UPB3	48°01'05.6"	166°36'22.5"
UPB4	48°01'05.5"	166°36'21.9"
UPB5	48°01'05.9"	166°36'21.4"
UPB6	48°01'05.6"	166°36'21.2"
UPB7	48°01'05.8"	166°36'20.5"
UPB8	48°01'05.8"	166°36'19.8"
UPB9	48°01'06.6"	166°36'19.9"
UPB10	48°01'06.9"	166°36'20.5"
UPB11	48°01'07.0"	166°36'20.9"
UPB12	48°01'06.6"	166°36'22.5"

For Mollymawk Bay (MB):

MB1	48°01'38.6"	166°36'48.0"
MB2	48°01'38.6"	166°36'48.6"
MB3	48°01'38.5"	166°36'50.0"
MB4	48°01'38.9"	166°36'50.2"
MB5	48°01'39.2"	166°36'50.1"
MB6	48°01'39.4"	166°36'48.6"
MB7	48°01'39.6"	166°36'48.6"
MB8	48°01'39.5"	166°36'47.9"
MB9	48°01'39.5"	166°36'47.3"

### 3.4 Placement of long-term trail cameras

Most of the birds within the study colonies breed on sloping ground under the canopy of *Veronica elliptica* and *Olearia lyalli*, and so there are few sites suitable for the placement of trail cameras to record the year-round activity at a number of nests within the breeding colonies. No suitable sites were available at the Lower Punui Bay study colony. However, suitable sites were found in the adjacent South Punui Bay colony and the Upper Punui Bay and Mollymawk Bay study colonies. In all situations the trail cameras could be attached to a tree. Examples of potentially suitable sites within the three colonies noted here are shown in **Figure 3-4**, Figure 3-5 and Figure 3-6.





**Figure 3-4: South Punui Bay, showing an area where up to nine pairs of breeding southern Buller's albatrosses could be monitored by a trail camera.**



**Figure 3-5:** Snares Islands Upper Punui Bay colony, showing an area where up to eight pairs of breeding southern Buller's albatrosses could be monitored by a trail camera .



**Figure 3-6: Snares Islands Mollymawk Bay study colony, showing an area where up to six pairs of breeding southern Buller's albatrosses could be monitored by a trail camera.**

## 4 Discussion

Despite adverse weather again resulting in incomplete coverage of North East Island the results of this field work indicate that the breeding population of southern Buller's albatrosses at the Snares Islands in 2020 was similar to that estimated using the same methods in 2002 and 2014. In addition, information from annual counts of the numbers of southern Buller's albatrosses breeding in three study colonies between 1992 to 2020 indicates that such annual counts provide a useful index of trends in the whole-island population.

### 4.1 Whole-island counts

A comparison of the total numbers of breeding pairs counted in comparable areas in the six counts completed between 1969-2020 indicates that numbers have remained relatively similar since 1997, with estimated total numbers of breeding pairs recorded in the same areas of the East Coast, North Promontory, West Coast, and South Coast, of 4718 (1997), 4980 (2002), 5305 (2014) and 5178 (2019-20). This followed a period of rapid population growth from 2574 pairs in 1969 and 3898 pairs in 1992.

The estimated numbers of breeding pairs on Broughton Island appear more variable than those for North East Island, with 539, 518, 657 and 621 pairs counted in 1992, 1997, 2014, and 2019, respectively.

Previously, Sagar & Stahl (2005) showed that ground counts were both accurate and precise, and so the trend of increasing numbers over time recorded by this method is assumed to be real. On North East and Broughton Islands most nests counted from vantage points were on ledges of steep cliffs. In 1992, such ledges were already fully occupied by albatross nests, unlike the breeding colonies under the forest and accessible to ground counting. Consequently, there appears to be scope for expansion of breeding colonies under the forest, unlike those sited on ledges.

The proportion of occupied nests recorded from ground counts increased throughout the period 1992 to 2014, while the proportion recorded by vantage-point counts decreased (Sagar 2014). The results of the 2019 and 2020 counts indicate a sharp increase in the proportion of nests recorded by ground counts compared to vantage-point counts. However, this does not indicate a large expansion of nesting southern Buller's albatrosses into accessible forest areas, but rather reflects the geography of the Snares Islands where the South West Promontory and South Coast provide greater areas of inaccessible cliffs for the nesting albatrosses than are available on the East Coast and North Promontory where the counts were completed in 2019.

### 4.2 Study colonies

Information from the three study colonies overall suggests that the breeding population peaked during 2005-2006, then trended downward until 2010 and subsequently 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 2020 were higher than those recorded in 2019 and were above the long-term average for the period 1992-2019. This indicates that the annual counts of pairs breeding in the study colonies provide an index of numbers breeding on North East Island as a whole.

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; Table 3-4 and Figure 3-2). Since 2012 the 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. Data presented in this report support this suggestion.

The return and recruitment rates of known-age birds banded between 1992-2004 shows considerable variation both within colonies between years and between colonies within the same year. Although future field work is likely to increase both return and recruitment rates for the 2000-2004 cohorts, few new birds are likely to be recaptured from cohorts banded 1992-1999 inclusive.

A combination of an apparent recent decline in annual survival rates of breeding birds and incorporation of the 2019-2020 count data and the mark-recapture data from the three study colonies 2008-2020 into an updated SEABIRD model analysis will provide a more robust estimation of population trend in this species.

The recapture of a southern Buller's albatross banded as a chick on Big Solander Island in 2002 is the second recorded movement of birds between these populations. The first was of a female loafer in the Mollymawk Bay study colony in March 2005, which had been banded as a chick on Big Solander Island in July 1997. Although neither of these birds was breeding at the Snares Islands they do support the evidence of microsatellite DNA data that suggest that sufficient gene flow occurs between the Snares Islands and Solander populations to maintain a genetically homogeneous population overall (van Bekkum *et al.* 2006).

## 5 Future work

Two further work components emerged during the Technical Working Group review process for this project. Firstly, estimating adult survival by gender would be a natural extension of the overall adult survival estimates presented here. Survival estimates by gender will be incorporated into the final annual report at the end of the third year (May 2022) of this project. Secondly, a more comprehensive modelling approach could be applied to the entire data set to estimate parameters other than adult survival. Such modelling could follow that undertaken by Francis & Sagar (2012), which used NIWA's 'SEABIRD' model and incorporated data up to and including those from 2007. However, a comprehensive re-modelling of southern Buller's albatross data would be beyond the scope of this project and would ideally require a separate project that could incorporate 'new' data from 2008-2022 when this project is completed.

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