

Population studies of Southern Buller's albatrosses on The Snares

Population study of Buller's Albatrosses

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Reviewed by



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Rosemary Hurst

Executive summary

This report presents a summary of the results of whole-island counts of Southern Buller's Albatross *Thalassarche bulleri bulleri* breeding at The Snares from 23 February to 4 March 2014 and compares these results with those obtained using similar methods during 1969, 1992, 1997 and 2002. In addition, the results of detailed demographic studies at three study colonies are presented.

The whole-island survey used similar methods and was completed at a similar time of year to previous counts, completed during 1969, 1992, 1997 and 2002. The survey of North East Island and adjacent Alert Stack resulted in an estimate of 8047 breeding pairs, which was very similar to the 8165 breeding pairs estimated in 2002, indicating that the increase in size of the breeding population over the period 1969-2002 had not continued. An additional 657 breeding pairs were estimated on Broughton Island.

Demographic studies at the three study colonies on North East Island have been undertaken annually since 1992, 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, showed substantial increases in all three colonies over the numbers recorded during 2013. 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 320 birds that had been banded previously in the study colonies as breeding adults of unknown age were recaptured. A further 39 breeding birds were banded in the study colonies - these are presumed to be first-time breeders. During the period 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 159 of these birds were recaptured, with birds from cohorts banded from 1998 to 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. A further 38 known-age birds were found breeding for the first time, and so were recorded as being recruited to the breeding population.

Incorporation of the 2014 whole-island count data and the mark-recapture data from the three study colonies 2008-2014 into an updated SEABIRD model analysis, as proposed by the Ministry for Primary Industries, will provide a more robust estimation of population trend in this species.

1 Background

This project was funded by Deepwater Group Limited, the Department of Conservation and the Ministry for Primary Industries. The purpose of the project was to conduct a whole-island survey of 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.
2. Resurvey three established study colonies.
3. Establish the numbers of pairs breeding in the three established study colonies.
4. Establish annual survival of banded birds from recapture data.

This report describes the field work completed at The Snares under permits (Entry 38392-LND and Research and Collection SO-32541-FAU) granted by the Department of Conservation.

Field work centred on completing an accurate estimate of the numbers of pairs of Southern Buller's Albatrosses breeding on North East and Broughton islands for comparison with similar counts completed in 1969, 1992, 1997 and 2002. 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. This was the twenty third consecutive year of recording demographic data of Southern Buller's Albatrosses in these study colonies at The Snares.

2 Methods

2.1 Logistics

Logistical support was provided by *RV Tiama* (skipper/owner Henk Haazen). The field team (comprising Paul Sagar (NIWA), Richard Wells (Deepwater Group) and Tamar Wells (student, Victoria University of Wellington) were dropped off at North East Island on 22 February 2014. *Tiama* returned to The Snares on 2 March and transported the party to Broughton Island on the morning of 4 March before returning all party members to Bluff on 5 March 2014.

2.2 Whole-island counts

The Snares ($48^{\circ} 02'S$, $166^{\circ} 36'E$) comprise North East Island (280 ha) and Broughton Island (90 ha), plus numerous islets and stacks (Figure 3-1). The laying period of Southern Buller's Albatrosses 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 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 22-28 Feb 2014, with the count on Broughton Island completed on 4 March 2014. 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 plus broken and abandoned eggs are presumed to represent the number of pairs of birds breeding each year.

When counting incubating birds we followed the procedure used in 1992, 1997 and 2002, 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 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 are considered to represent the minimum number of breeding pairs.

On Broughton Island ground counts and vantage point counts were completed in the same way as on North East Island. However, along the south east coast the near-vertical terrain

did not allow ground or vantage point counts, and so counts of occupied nests were made from digital photographs taken when *Tiama* was about 300 m offshore of this coast. Counts from digital photographs were made by using landmarks to define non-overlapping areas in which all birds apparently sitting on a nest were counted. Birds obviously sitting on bare ground or rock were not included in such counts.

2.3 Study colonies

Each of three study colonies (Mollymawk Bay, Lower Punui Bay, and Upper Punui Bay) on North East Island was visited twice; Upper and Lower Punui Bay on 22 Feb and 1 March 2014, and Mollymawk Bay on 23 February and 3 March 2014. 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.

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.

3 Results

3.1 Whole-island counts

On North East Island, the greatest numbers of occupied nests occurred on the South Coast, East Coast, North Promontory and the south side of the South-West Promontory (Figure 3-1, Table 3-1).

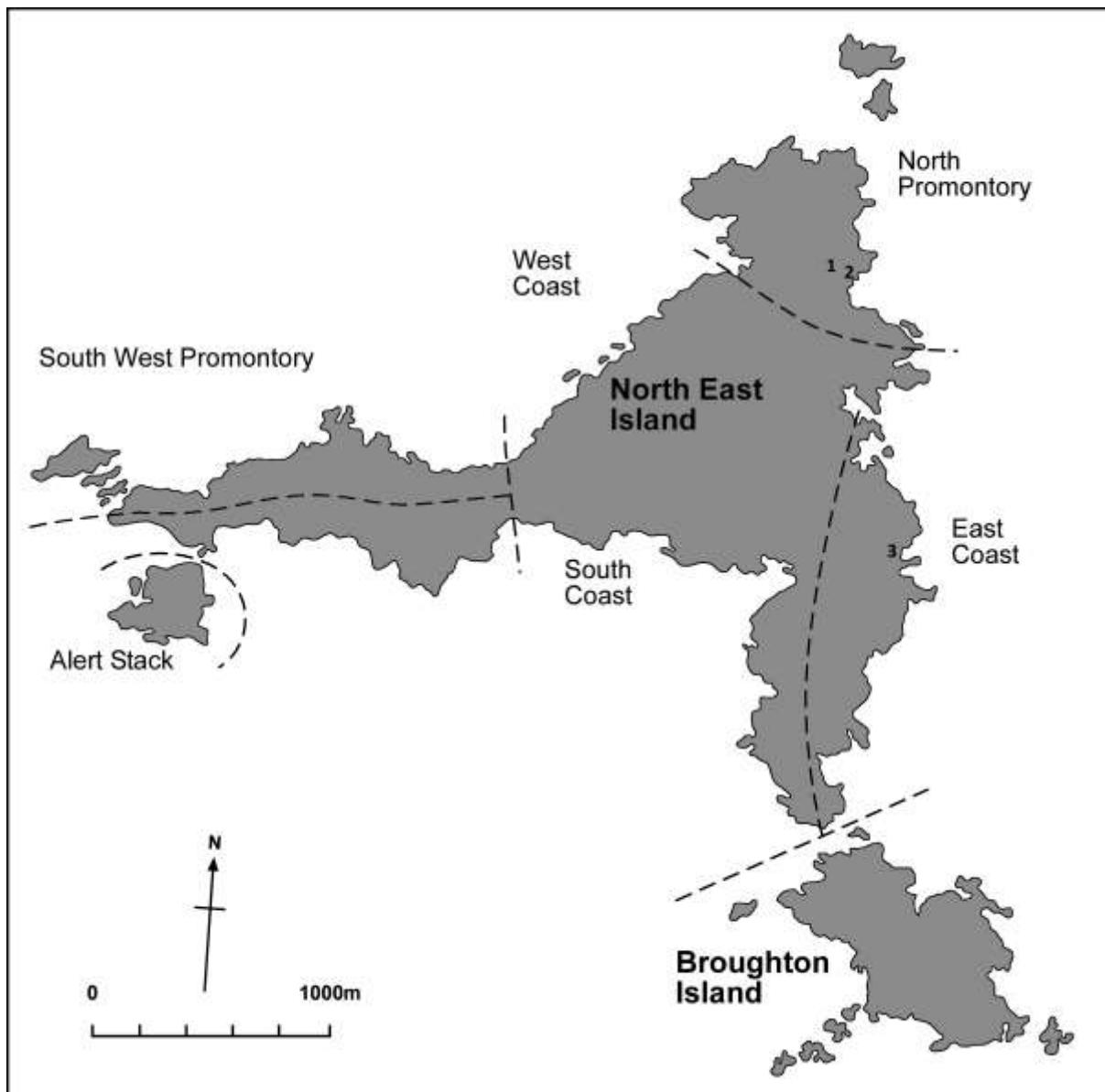


Figure 3-1: The Snares, showing the boundaries of areas where counts of occupied nests of Southern Buller's Albatrosses were made. Locations of study colonies are: 1, Upper Punui Bay; 2, Lower Punui Bay; 3, Mollymawk Bay.

Table 3-1: Numbers of occupied nests of Southern Buller's Albatross counted in different areas of The Snares, 1969-2014.

Values in parenthesis 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. Data for 1969-2002 are from Sagar & Stahl (2005).

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

A total of 8047 occupied nests (assumed to equate to breeding pairs) was counted on North East Island and Alert Stack, with a further 657 counted on Broughton Island, for a combined total of 8704 occupied nests (Table 3-1). The total for North East Island and Alert Stack comprised 4971 from ground counts and 3076 from vantage point counts. These totals are similar to those made 1992-2002 (Table 3-2), showing that whilst ground-count totals increased over time, the vantage-point totals remained similar from 1992 to 2002, but decreased by 2014 (Table 3-2).

Table 3-2: Counts and % of total (in parentheses) of occupied nests of Southern Buller's Albatrosses made by ground counts and vantage-point counts, North East Island and Alert Stack, The Snares.

Data from 1992-2002 are from Sagar & Stahl (2005).

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

Most vantage point counts were made by all three observers, with individual totals of 2414, 2507 and 2560 occupied nests. The remaining vantage point counts were made by one or two observers. Likewise, the total for Broughton Island comprised 432 from ground counts, 79 from vantage point counts, and 146 from at-sea photo-counts. Vantage point counts from all three observers were 79, 79 and 78 occupied nests.

3.2 Study colonies

3.2.1 Numbers of occupied nests

Totals of 132, 64 and 85 nests with an egg were counted in the Mollymawk Bay, Lower Punui Bay and Upper Punui Bay study colonies, respectively (Figure 3-2). Of these totals, three nests in Mollymawk Bay each contained the remains of a broken egg and in the Lower Punui Bay colony four nests contained the remains of a broken egg and a further four nests each contained an abandoned (= no bird present and egg cold) egg or had an egg beside the nest mound, and so assumed to have rolled out of that nest.

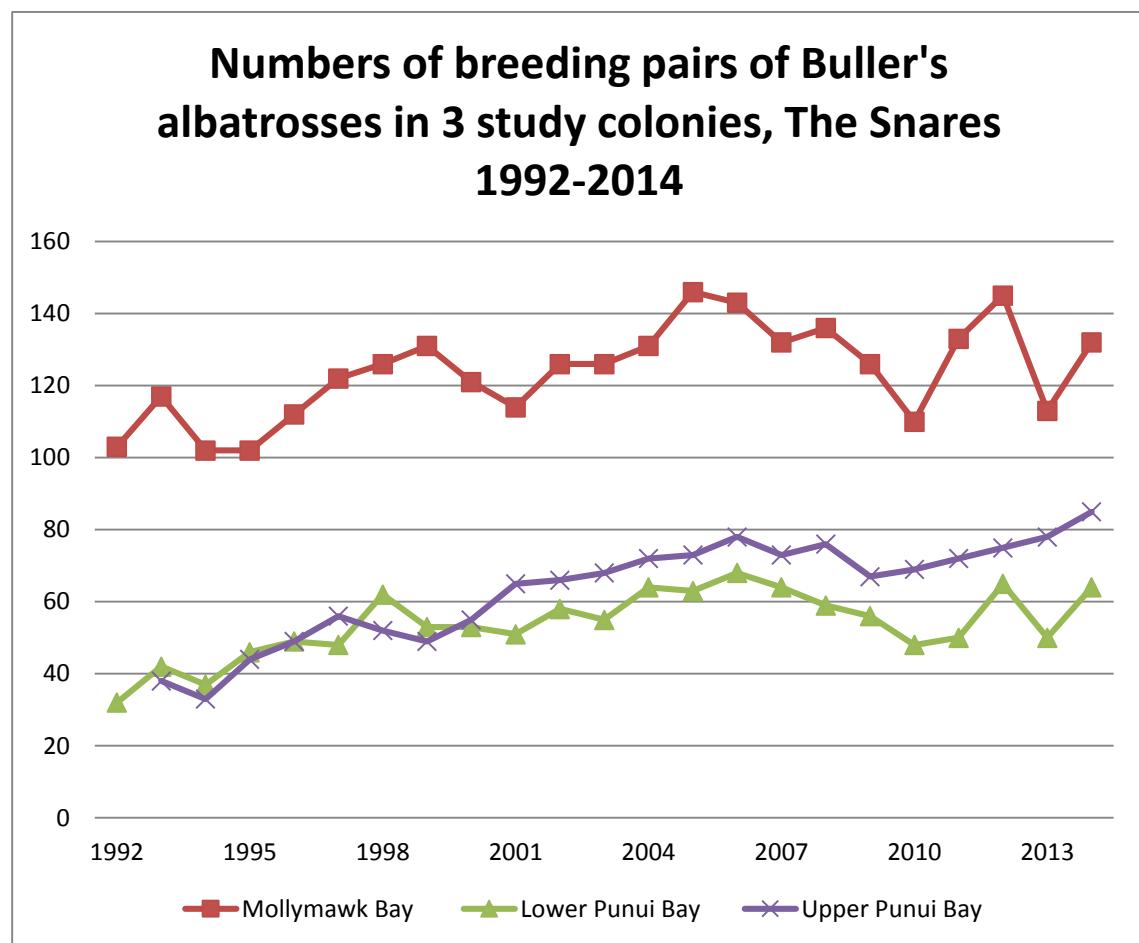


Figure 3-2: Numbers of breeding pairs of Southern Buller's albatrosses counted annually at three study colonies, The Snares 1992-2014.

These totals represent increases, relative to numbers counted in April 2013, in the Mollymawk Bay, Lower Punui Bay and Upper Punui Bay of 16.8%, 28.0% and 9.0%, respectively. These trends show a consistent pattern, with the numbers of breeding pairs in the Mollymawk Bay and Lower Punui Bay changing similarly between years, whilst the numbers of breeding pairs recorded in the Upper Punui Bay study colony show a steady increase.

3.2.2 Adult survival

A total of 320 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 39 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).

Banding schedules for all newly banded birds have been submitted to the Banding Office, Department of Conservation, Wellington.

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, 159 were recaptured during February-March 2014. 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 1998 cohort, and so were 16 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 10 years old), 469 (23.6%) have been recaptured. The lowest rate of return (2.8%, three 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 3-3).

Table 3-3: Number (% of total banded) of Southern Buller's Albatrosses, banded as well-grown chicks in 1992-2004, returning to The Snares, by colony of provenance.

Colony/ cohort	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Mollymawk Bay	19 (27.1)	27 (30.7)	26 (37.1)	6 (26.1)	19 (22.4)	20 (21.0)	32 (39.5)	31 (35.2)	18 (20.2)	15 (18.5)	16 (16.8)	17 (17.9)	13 (13.1)
Punui Bay	20 (43.5)	12 (20.7)	18 (41.9)	27 (44.3)	21 (32.3)	26 (34.7)	17 (22.1)	8 (15.7)	17 (20.2)	13 (15.9)	11 (11.7)	3 (2.8)	17 (19.1)

With no new birds recaptured in the three study colonies during February-March 2014 from the 1992 to 1997 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 the percentage of banded known-age birds returning varied from 26.7% (1993 and 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 9.9% (2003 cohort) to 20.2% (2000 cohort) indicating that more birds from these cohorts have yet to be recaptured.

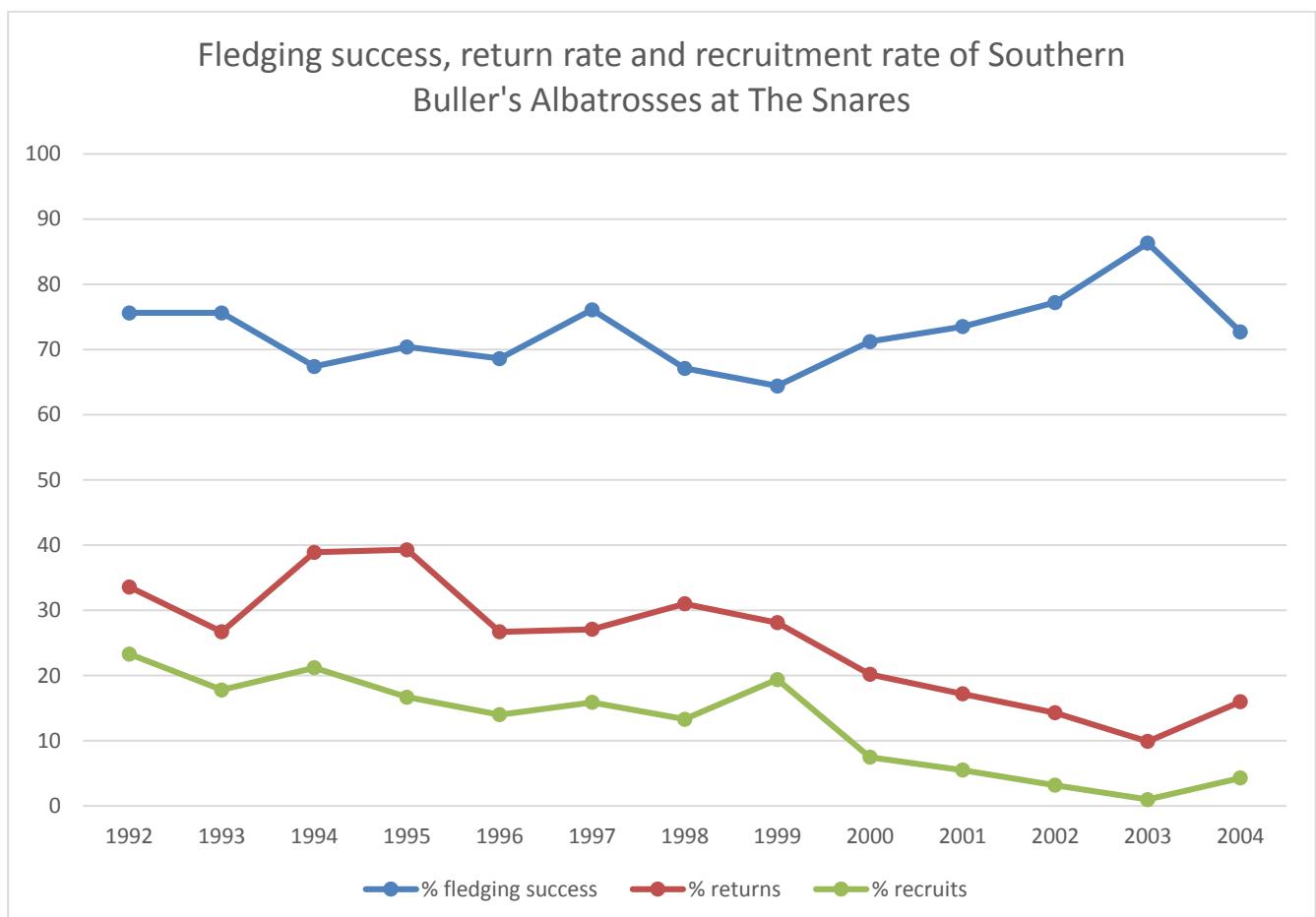


Figure 3-3: Fledgling success and return and recruitment rates of Southern Buller's Albatrosses banded as chicks in three study colonies at The Snares, 1992-2004.

Recruitment rate 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.

In February-March 2014, 38 known-age birds, banded as chicks in the study colonies, were found breeding for the first time i.e., they had recruited to the breeding population. Of these, five were aged 10 years (banded as chicks in 2004), two were aged 11 years (banded as chicks in 2003), five were aged 12 years (banded as chicks in 2002), two were aged 13 years (banded as chicks in 2001), five were aged 14 years (banded as chicks in 2000), six were aged 15 years (banded as chicks in 1999), eight were aged 16 years (banded as chicks in 1998), one was aged 17 years (banded as a chick in 1997), two were aged 18 years (banded as chicks in 1996), one was aged 19 years (banded as a chick in 1995), and one was aged 21 years (banded as a chick in 1993).

A plot of recruitment rate, by cohort, of birds banded as chicks 1992-2004 (Figure 3-3) shows an apparent decline throughout this period. However, given that the mean age of first breeding of Southern Buller's Albatrosses at The Snares 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 15-22 years. Currently, these range from 8.7% for the 1995 cohort from Mollymawk Bay to 28.7% for the 1992 cohort from Punui Bay (Table 3-4). In addition, there is considerable variation in the recruitment rate both between years and between colonies in the same year (Table 3-4).

Table 3-4: Numbers (% of total banded as well-grown chicks) of known-age Southern Buller's Albatrosses recruits (i.e. ,returning to breed) to The Snares, by colony of provenance, for cohorts banded 1992-1999.

Colony/cohort	1992	1993	1994	1995	1996	1997	1998	1999
Mollymawk Bay	14 (20.0)	18 (20.5)	14 (20.0)	2 (8.7)	8 (9.4)	8 (8.4)	11 (13.6)	20 (22.7)
Punui Bay	13 (28.3)	8 (13.4)	11 (25.6)	12 (19.7)	13 (20.0)	19 (25.3)	10 (13.0)	7 (13.7)

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 13.3% (1998 cohort) to 23.3% (1992 cohort). Currently, the recruitment rate of known-age birds banded 2000-2004 varies from 1% (2003 cohort) to 7.5% (2000 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 breeding birds were banded during studies in 1948, 1961 and most years 1967-1977. None of these was recorded during February-March 2014. 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). Four of these birds were recorded during February-March 2014, three of them incubating and one on an empty nest. At 42 years these are the oldest known-age Southern Buller's Albatrosses.

4 Discussion

Results of this field work indicate that the breeding population of Southern Buller's Albatrosses at The Snares in 2014 was similar to that estimated by similar methods in 2002. In addition, information from annual counts of the numbers of Southern Buller's Albatrosses breeding in three study colonies 1992 to 2014 indicates that such annual counts provide a useful index of trends in the whole-island population.

4.1.1 Whole-island counts

There have now been five whole-island counts of the numbers of breeding pairs of Southern Buller's Albatrosses on North East Island and Alert Stack, The Snares, during the period 1969-2014. The results of these counts show that the population increased markedly and more than doubled between 1969 and 2002 (4024 vs. 8165 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 2002 (8165) and 2014 (8047) counts indicates a decline of 1.45% over the 12 years (-0.12%/annum). Such a value would be well within the margin of error of the vantage-point counts, and so the 2014 population should be considered to be similar to that estimated in 2002.

The estimated numbers of breeding pairs on Broughton Island appear more variable than those for North East Island, with 539, 518 and 657 pairs counted in 1992, 1997 and 2014, respectively. However, examination of the field notes for these counts show that in addition to ground counts and vantage-point counts, at-sea counts were made only in 1992 and 2014, and so only the totals for these years may be compared directly. These indicated an increase of 21.9% between 1992 and 2014, compared to an increase of 12.6% over the same period on North East Island.

Previously, Sagar & Stahl (2005) showed that ground counts were both accurate and precise, and so 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. This could explain why 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.

4.1.2 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 2014 are broadly similar to those recorded in 2002, the year of the previous whole-island count. 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 1992-1997 (Sagar et al. 2000) followed by declines through to 2007 at least (Francis & Sagar 2012).

The return and recruitment rates of known-age birds banded 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 cohorts 2000-2004, few new birds are likely to be recaptured from cohorts banded 1992-1999 inclusive. Currently, the return rates for cohorts banded in 1994 and 1995 are higher than in any other years and there appears to be an annual decline in the recruitment rate for cohorts banded 1992-1998.

A combination of an apparent recent decline in annual survival rates of breeding birds and reduced recruitment of known-age birds could lead to a decline in overall abundance. Incorporation of the 2014 whole-island count data and the mark-recapture data from the three study colonies 2008-2014 into an updated SEABIRD model analysis, as proposed by the Ministry for Primary Industries, will provide a more robust estimation of population trend in this species.

5 Acknowledgements

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