

Demography and tracking of Buller's Albatrosses at The Snares, and tracking of Snares Crested Penguins and Rockhopper Penguins from The Snares and Campbell Island respectively: Final research report of the 2013 field season

Prepared for Department of Conservation

June 2013

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NIWA Client Report No: CHC2013-064
Report date: June 2013
NIWA Project: TMMA133

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Summary

This report presents the results of demographic and tracking studies of Buller's Albatross *Thalassarche bulleri* at three study colonies at The Snares during 11-29 April 2013. In addition, the report presents the results of the deployment stage of tracking Snares Crested Penguins *Eudyptes robustus* at The Snares, Rockhopper Penguins *E. filholi* at Campbell Island, and Erect-crested Penguins *E. sclateri* at the Bounty Islands.

Demographic studies at three study colonies of Buller's Albatross 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, showed substantial declines in two colonies and a slight increase in the third. A total of 353 birds banded previously as breeding adults of unknown age were recaptured within the study colonies. A further 28 breeding birds were banded in the study colonies. The oldest bird in the study colonies was banded as a breeding bird of unknown age in 1969. Assuming a minimum age of first breeding of ten years, this bird was at least 53 years old in April 2013.

During the period 1992-2004 all chicks that survived to near-fledging were banded, and their survival to return to the study colonies in subsequent years has been monitored. This year 91 of these birds were captured, with birds from cohorts banded from 1999 to 2004 being recaptured for the first time, showing that long term monitoring is required to obtain reliable estimates of survival of such known-age birds. There is a strong male bias in the known-age birds recaptured, but some of this is explained by females being less likely than males to be recaptured. The average age of first breeding is 10-12 years, and recruitment to the breeding population varies widely, so further years of recapture are required before the recruitment rates of all cohorts 1992-2004 can be estimated reliably.

GPS tracking of 20 birds showed that, during the guard stage, Buller's Albatrosses foraged over the Snares Shelf and around Stewart Island and the lower South Island. Females tended to forage to the south-east and north-west whilst males foraged to the south-east and north-east of The Snares. Such differences in foraging areas between males and females was consistent with results from GPS tracking during the guard stage from 2008 to 2011.

Totals of 45 and 44 light-based global location sensing (GLS) tags were successfully deployed on Rockhopper Penguins and Snares Crested Penguins, respectively. In all cases, birds approaching the end of the moult process were selected. GLS tags will be retrieved in October 2013 when penguins return to their breeding colonies following the non-breeding period at sea. No tags were deployed on Erect-crested Penguins at the Bounty Islands due to logistic constraints the timing of the visit to the islands was too late in the year, penguins having completed moult and departed to sea for the winter.

1 Background

This project was completed with support from National Geographic, the Ministry of Business, Innovation and Employment (New Zealand) and NIWA. The main aims of the project were:

1. To build upon the comprehensive demographic database for Buller's Albatrosses *Thalassarche bulleri bulleri* at The Snares;
2. To determine the fine-scale at-sea distribution of Buller's Albatrosses during the chick guard stage; and
3. To determine the at-sea distribution of Snares Crested Penguins *Eudyptes robustus*, Rockhopper Penguins *E. filholi* and Erectt-crested Penguins *E. sclateri* during the non-breeding period (April-October).

This report describes the field work completed under permits (Entry 1112/76 and Research and Collection SO-32541-FAU for Buller's Albatross, and Entry 1213/57, Entry 1213/56 and Entry 1213/60 and Wildlife Act Authority 35682-FAU for Snares Crested Penguin, Rockhopper Penguin and Erect-crested Penguin, respectively) granted by Southland Conservancy, Department of Conservation, during the 2013 field season at The Snares and Campbell Islands. The main aims of the Buller's Albatross field work were to update population size and adult mortality estimates and foraging distributions. Specifically, the additional information will be used to:

1. Examine long-term trends in the numbers of breeding pairs of Buller's Albatrosses in three long-term study colonies (Mollymawk Bay, Lower Punui Bay, and Upper Punui Bay);
2. Estimate adult survival;
3. Determine breeding frequency of banded birds;
4. Record the colony attendance of banded pre- and non-breeding birds; and
5. Examine the fine-scale at-sea distribution of breeding birds during the chick guard stage with respect to potential overlap with fishing activities for comparison with data collected during similar periods in April 2008 - April 2011.

Field work for Buller's Albatross centred on obtaining further information regarding the population dynamics, particularly population size, adult survival, breeding frequency, and recruitment. Demographic data will be analysed using NIWA's dedicated seabird demographic model as part of complementary DOC and MPI supported research. This was the 22nd consecutive year of recording demographic data for this species at The Snares.

Penguin work focused on the deployment of light-based global location sensing (GLS) tags in order to determine the non-breeding, winter movements and distributions of three species of crested penguins. Location information will necessitate the recapture of tagged penguins when birds return to their breeding sites at the start of the 2013-14 breeding season in order to retrieve GLS tags and download data. Tag retrieval will be achieved through separate, dedicated trips in the spring of 2013.

2 Methods

2.1 Logistics

After dropping off a team comprising Paul Sagar, Leigh Torres and David Thompson at The Snares on 11 April 2013 *RV Tiama* (skipper Henk Haazen) continued to Campbell Island, where Kyle Morrison, Phil Battley and Andy Whittaker disembarked for the period 14-15 April. Following completion of the field work on Campbell Island *Tiama* returned to The Snares on 18 April to pick up the team, and then return all to Bluff on 20 April. On a separate trip, *Tiama* departed Bluff on 22 April heading for the Bounty Islands where Andy Whittaker attempted to deploy GLS tags on Erect-crested Penguins.

2.2 Buller's Albatrosses

2.2.1 Demographic data

Each of the three study colonies (Mollymawk Bay, Lower Punui Bay, and Upper Punui Bay) was visited daily from 11 to 19 April. During 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 were captured and fitted with a uniquely numbered stainless steel leg band. All adult birds recorded on this first visit were marked with raddle (a temporary stock marker) so that they were not recaptured on our subsequent visits. Subsequently, all nests in each colony were checked, any unmarked birds were captured, and band numbers were recorded or leg bands applied, as appropriate. In addition, on each visit an attempt was made to recapture as many banded non-breeding birds as possible.

All results reported refer to data collected within the three study colonies unless otherwise stated.

2.2.2 Tracking data

The at-sea range of Buller's Albatrosses was assessed by the deployment and retrieval of 20 GPS loggers (IgotUs), set to record a location every two minutes. The GPS loggers weighed ca. 38 g and were attached to feathers on the bird's dorsal surface, between the wings, using waterproof Tesa© tape. Deployment and retrieval of devices was completed in less than five minutes for each bird.

2.3 Penguins

In all cases, British Antarctic Survey (BAS, Cambridge, UK) Mk19, now Biotrack (Wareham, UK) MK3005, light-based GLS archival tags were deployed on penguins at or near completion of the moult process. Each GLS tag and its associated attachment hardware weighed less than 3 g, well within the 3% threshold commonly adopted for tracking device deployments.

We began by attaching a band to the bird's leg comprising a length of flat-sided and round-edged dual-core cable sheath (i.e. the sort of cable typically found on laptop power adaptors and which has the two 'core' wires removed to leave the sheath only). A cable tie was inserted inside the cable sheath in place of the core wires and secured on the bird's leg to

form a snug-fitting tear-shaped band around the leg. This band was able to spin freely on the leg, but not slip over the knuckle when the pointed end of the teardrop was rotated to the back of the leg and pressed down. The GLS tag was attached to this teardrop-shaped band with a second, smaller cable tie. For additional adhesion, a strip of self-amalgamating tape was wrapped around the middle of the GLS tag prior to deployment. The head of the second cable tie was pointed up into the feathers rather than down into the foot to avoid any potential abrasion to the bird's leg or foot. The GLS and its attaching cable tie were positioned so that the GLS sat over the point of the teardrop band around the bird's leg, and where the tail of the first, larger cable tie (running through the sheath) enters the cable tie head. This ensured that the small cable tie was tucked into the corner or point of the teardrop-shaped band so it did not rub, and sat flat along the head of the cable tie that runs through the sheath.

3 Results and discussion

3.1 Buller's Albatross

3.1.1 Demographic data

Study colonies

Counts of nests where breeding had occurred that season (based on the presence of an egg or chick, or the remains thereof) were made in each colony. During 2013 totals of 113, 50 and 78 nests with an egg or chick were counted in Mollymawk Bay, Lower Punui Bay and Upper Punui Bay, respectively. These totals represent decreases, relative to the numbers counted during April 2012, of 22% and 23.0% in Mollymawk Bay and Lower Punui Bay, respectively and an increase of 4% in Upper Punui Bay. Over the 22 years of this study there was a consistent pattern, with numbers of breeding pairs in the Mollymawk Bay and Lower Punui Bay study colonies changing similarly between years, whilst the numbers of breeding pairs recorded in the Upper Punui Bay study colony have increased (Figure 3-1).

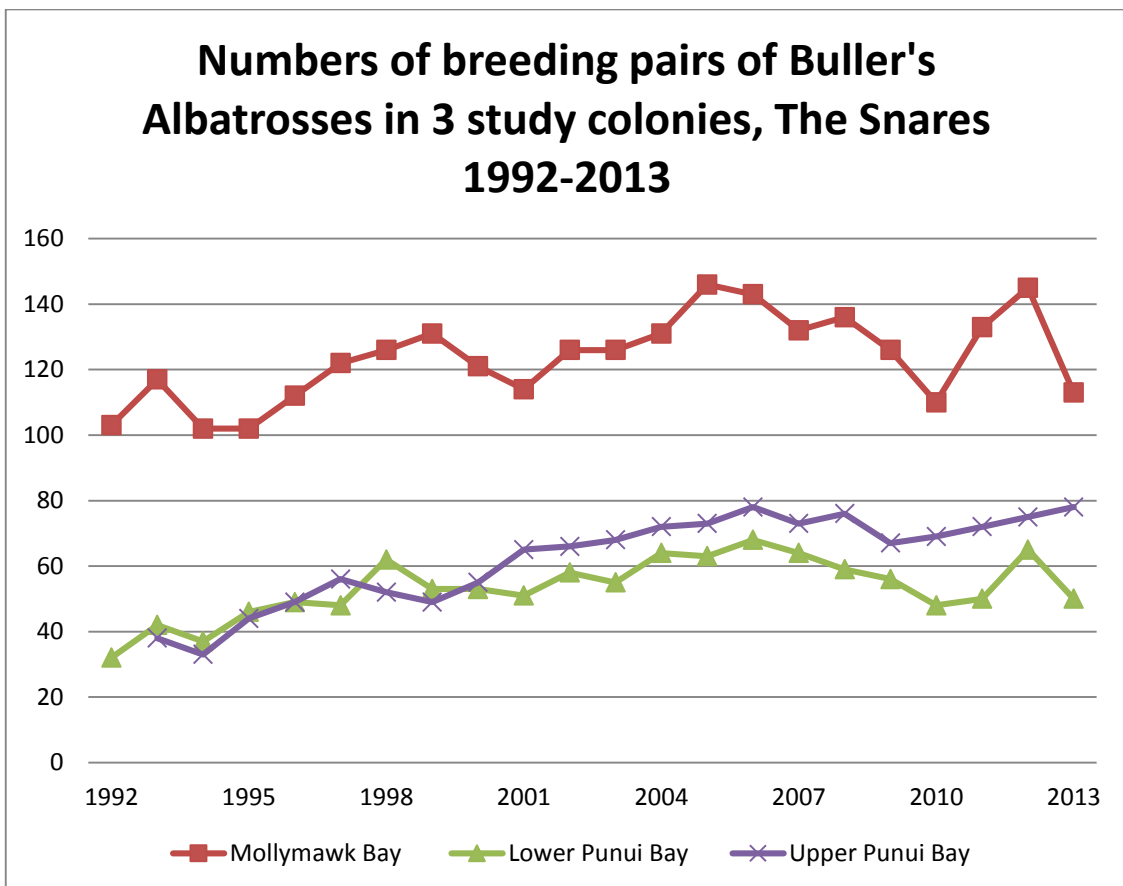


Figure 3-1: Numbers of breeding pairs of Buller's Albatrosses counted annually at three study colonies, The Snares 1992-2013.

3.1.2 Productivity

Of 241 nests counted in the three study colonies on 12 April 2013, 65 (27%) contained an egg, 12 (5%) contained a broken egg, 160 (66%) contained a chick, and 4 (2%) contained a dead chick. Of the extant chicks, 156 (97.5%) were being guarded by an adult (i.e. at the guard stage), and 4 (2.5%) were alone at the nest (post-guard stage). Since 2006 annual visits to the study colonies had been made during the first two weeks of April, when all chicks were at the guard stage, and so our 2013 visit indicates the rapid switch to the post-guard stage by the end of the month.

Number of broken eggs (12) and dead chicks (4) were similar to those recorded in 2010, when El Nino conditions prevailed. This year sea surface temperatures in the region were higher than normal despite there being no strong El Nino or La Nina conditions.

3.1.3 Adult survival

A total of 353 birds banded previously as breeding adults of unknown age were recaptured. This total comprised breeding birds, non-breeders and failed breeders. In addition, a further 28 breeding birds were banded within the study colonies.

Because birds breeding in the study colonies have been banded since 1992 we assumed that any unbanded birds captured are first-time breeders, and so likely to be 10-12 years old, the average age of first breeding (Francis & Sagar 2012).

The oldest bird recaptured during April 2013 was banded as a breeding bird of unknown age in January 1969. Assuming a minimum age of first breeding of ten years, these birds were at least 53 years old in April 2013.

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

3.1.4 Survival and recruitment of known-age birds

Return rate of known-age birds

The return rate of known-age 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, 91 were recaptured in April 2013. These birds were from cohorts banded from 1992 to 2004. The oldest known-age bird recaptured for the first time was from the 1999 cohort. This indicates that many more years of recapture effort is required to obtain reliable estimates of the survival of known-age birds in these albatrosses.

Of the 1991 birds banded as chicks near fledging in the study colonies during the period 1992-2004 (which would now be at least nine years old), 439 (22.1%) have been recaptured. The lowest rate of return (2.8%, 3/107) is for the 2003 cohort in Punui Bay (Lower and Upper study colonies combined) and highest rate of return (44.3%, 27/61) from the 1995 cohort in these same study colonies (Table 3-1). However, as indicated by the first-time recapture of a bird banded in 1994 and a plot of the return rate of birds banded as chicks from 1992 to 2004

(Figure 3- 2), these return rates are likely to increase with further recaptures in subsequent years, especially for cohorts banded from 1999.

Table 3-1: Number (% of total banded) of Buller’s Albatrosses, banded as well-grown chicks in 1992-2004, returning to The Snares, by cohort and 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)	30 (37.0)	30 (34.1)	16 (18.0)	14 (17.3)	15 (15.8)	14 (14.7)	7 (7.1)
Punui Bay	20 (43.5)	12 (20.7)	18 (41.9)	27 (44.3)	21 (32.3)	26 (34.7)	16 (20.8)	8 (15.7)	15 (17.9)	12 (14.6)	10 (10.6)	3 (2.8)	8 (9.0)

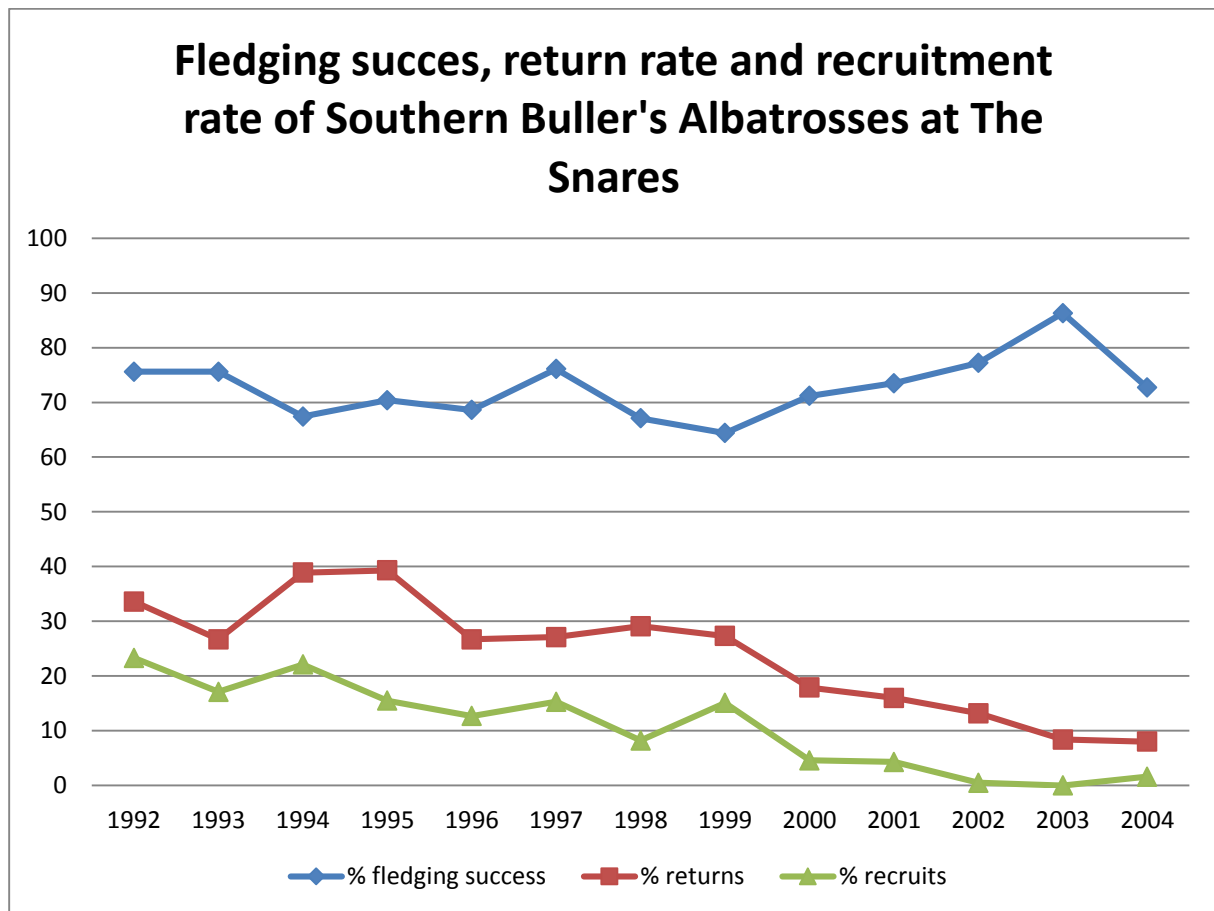


Figure 3-2: Fledging success and return rate and recruitment of Buller's Albatrosses banded as chicks in three study colonies at The Snares, 1992-2004.

As in previous years there was considerable bias in the sex ratio of the known-age birds recaptured, with 75.0% (66/88) estimated as males on the basis of leg and bill measurements. Of the 435 known-age birds recaptured since the start of this study where the sex was estimated from measurements or DNA analysis, 71.5% (312/435) were male. This male bias in the known-age may partially reflect gender-based differences in behaviour. Our observations have shown that pre-breeding females spend considerably less time ashore and visit colonies farther from their natal colony than do males. Consequently, females are less likely to be recaptured. However, more recently, we have shown that there was a male

bias in the sex of chicks fledged in the study colonies during 2002-2004, which would also have contributed to the observed male bias in the known-age birds recaptured.

Despite searches for banded birds in areas adjacent to the three study colonies, some birds, particularly females, will have settled elsewhere on The Snares (Sagar et al. 1998). Percentage returns from each cohort should therefore be considered as a minimum.

Recruitment rate of known-age birds

The recruitment rate of known-age Buller's Albatrosses is the proportion of a cohort of chicks recaptured as breeding adults several years after banding. This is usually less than the return rate because of mortality in the years between returning and the onset of breeding.

In April 2013, 11 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, four were aged 12 years (banded in 2001), four were aged 14 years (banded in 1999), two were aged 15 years (banded in 1998, and one was aged 19 years (banded in 1994).

The mean age of first breeding for Buller's Albatross at The Snares is 10-12 years (Francis & Sagar 2012). Although a plot of recruitment rates of birds banded as chicks from 1992 to 2004 (Figure 3-2) shows an apparent decline from 1999 the average age of 1st breeding of 10-12 years of first breeding suggests that more breeding birds from these cohorts are likely to be recorded in future. Therefore, it is probably prudent to estimate recruitment (i.e. the rate at which birds banded as chicks enter the breeding population) only for the 1992-1999 cohorts i.e. birds aged 14-21 years. Even so, recruitment rates for cohorts banded from 1997 are likely to increase with recaptures in future years. Currently, recruitment rates from the 1992-1999 cohorts range from 4.4% (for the 1995 cohort in Mollymawk Bay) to 28.3% (for the 1992 cohort in Punui Bay) (Table 3-2). Given the bias in the sex ratio of birds returning to their natal colonies (see above), our figures for the recruitment rate should be considered minimal. This is because it is likely that a proportion of females, in particular, will be breeding at other colonies, and so are less likely to be recaptured.

Table 3-2: Numbers (% of total banded as well-grown chicks) of known-age Buller's Albatrosses recruiting (i.e. returning to breed) to The Snares, by cohort and colony of provenance.

Colony/cohort	1992	1993	1994	1995	1996	1997	1998	1999
Mollymawk Bay	14 (20.0)	17 (19.3)	14 (20.0)	1 (4.4)	8 (9.4)	8 (8.4)	6 (7.1)	16 (18.2)
Punui Bay	13 (28.3)	8 (13.4)	11 (25.6)	12 (19.7)	11 (16.9)	18 (24.0)	7 (10.8)	5 (9.8)

3.2 Tracking data

3.2.1 Retrieval of GPS loggers

GPS loggers were used to track one foraging trip for each of 20 birds that were feeding a small chick during the guard stage. However, for three birds not recaptured on their first return to the nest we obtained tracking data on two consecutive trips. The birds were away

from the nest for <1 to 4 days. Even though the birds were away from the nest for only relatively short periods, plots of their movements (Figure 3-3) showed that they dispersed widely. Foraging activity was concentrated on the SE of the Snares Shelf, the shelf around Stewart Island, and the shelf edges to the east and west of Stewart Island. This was the fifth occasion that we have tracked Buller's Albatrosses at this time of year. As in the four years 2008-2011, an initial analysis of the duration and destination of trips of males and females indicated that females undertake trips of longer duration, mainly to the north-west and south-east, and males undertake shorter trips, mainly to the north-east and south-east.

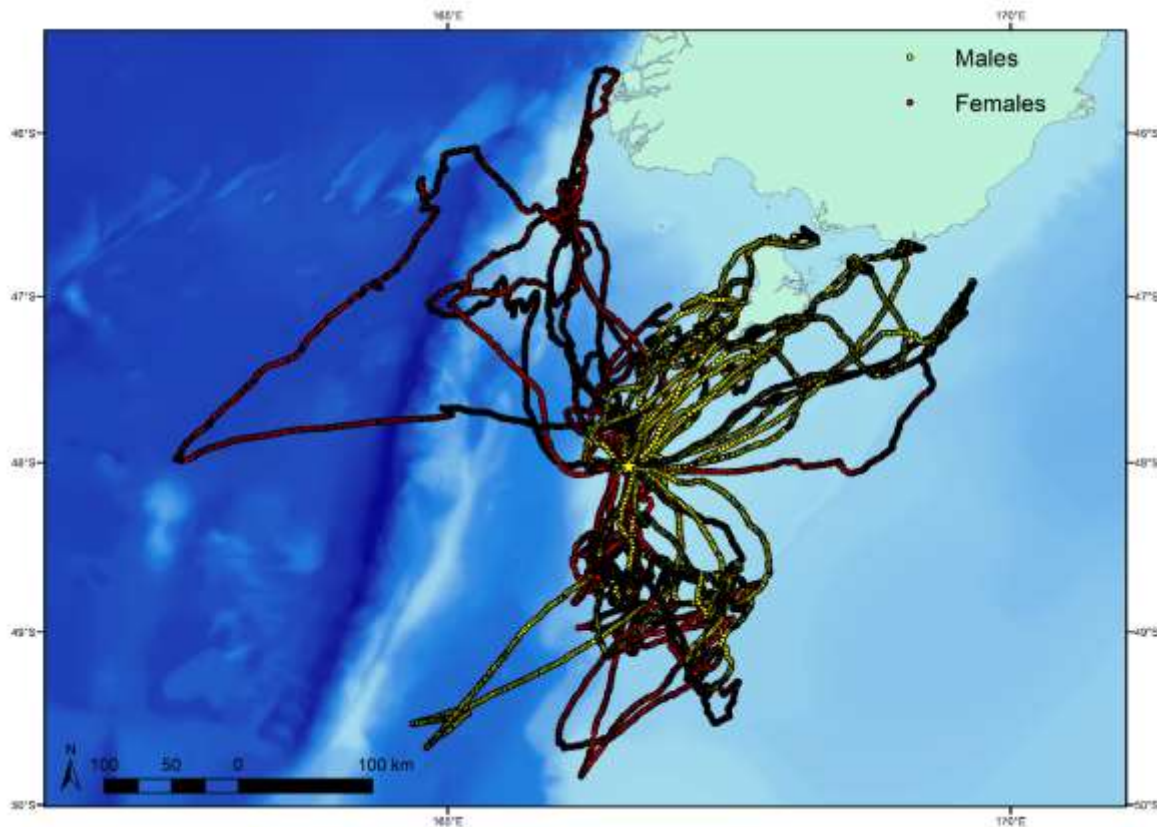


Figure 3-3: Tracks of the movement of 20 Buller's Albatrosses, by gender, from The Snares during the guard stage, April 2013, as indicated by GPS loggers.

3.3 Penguins

At The Snares, GLS tags were deployed on 44 Snares Crested Penguins (Figure 3-4) in a colony immediately inland from Station Cove. At Campbell Island, GLS tags were deployed on 45 Rockhopper Penguins at the East and West sub-colonies at Penguin Bay. All Rockhopper Penguins on which a GLS tag was deployed had been previously fitted with a subcutaneous PIT chip for identification and were of known sex (23 males, 22 females).

No GLS tags were deployed on Erect-crested Penguins at the Bounty Islands. On arrival at the islands there were very few penguins remaining and completing moult. It was decided that these 'stragglers' were sub-optimal birds in terms of GLS deployment and subsequent retrieval.



Figure 3-4: Snares Crested Penguin with GLS deployed on the right leg.

4 Research recommendations

4.1 Bird distribution and remote sensing data

4.1.1 Buller's Albatross

The GLS information collected from Buller's Albatrosses earlier in this study may now be analysed with respect to the marine ecosystems in which the birds forage. We recommend that the complete set of processed geolocator data be analysed to determine foraging distribution by gender, age, and breeding status of individuals. In addition, the foraging distribution of the birds could be overlain with other remote sensing datasets, such as, sea surface temperature, ocean colour and fishing catch effort to ascertain the environmental conditions encountered by foraging birds.

4.1.2 Crested Penguins

Provided GLS tags are successfully retrieved from Rockhopper Penguins and Snares Crested Penguins in October 2013, extracted location data will be analysed to reveal core foraging zones for both species in relation to a suite of environmental variables. These analyses will be undertaken in collaboration with researchers at BAS. Extending this approach to the two remaining New Zealand species of crested penguin (Erect-crested Penguin, and Fiordland Penguin *Eudyptes pachyrhynchus*) would produce a unique and formidable data set with which to explore non-breeding habitat use and marine resource use across this threatened group of penguins.

4.1.3 Interactions with fisheries

Buller's Albatross have been amongst the most frequently reported seabird bycatch in the New Zealand EEZ since the late 1980s (e.g., Bartle 1991; Murray et al. 1993; Conservation Services Programme 2008). More recently, they have been reported in the bycatch of small-scale fisheries off Peru and Chile (Mangels 2012). For the first time the kernel density distributions of Buller's Albatrosses obtained by geolocator tracking will allow an assessment of the timing and degree of overlap with various fisheries throughout the range of the birds. However, it should be borne in mind that overlap with fishing vessels does not equate to interaction because much of it is coincident, probably because both birds and fishing vessels are after the same prey. Therefore, identification of specific Buller's Albatross-fisheries overlap allows targeted fine-scale GPS tracking studies to be undertaken to distinguish between overlap and interaction rates (Torres et al. 2013).

We have already completed a fine-scale tracking study during the guard-stage for Buller's Albatrosses breeding at The Snares (Torres et al. 2013). This is the period when the birds forage relatively close to the island. During the incubation and post-guard stages birds forage over greater distances (Stahl & Sagar 2000), and so overlap with different fisheries. Therefore, It would be particularly useful to GPS-track Buller's Albatrosses during the post-guard stage (late April-early September), the period when they overlap with the trawl and longline fisheries which account for most of the recorded bycatch (Conservation Services Programme 2008). We recommend contemporaneous tracking of birds from both the

Solander Islands and The Snares, the two major breeding sites of this species, to compare the overlap of each breeding population with fisheries activities.

4.2 Long-term effects of environmental change and fisheries effort

This demographic study of Buller's Albatrosses at The Snares now extends from 1992 to 2013, and so provides an opportunity to use the population trend and survival data as indicators of environmental change. Therefore, we recommend the continuation of at least annual visits to The Snares to record the numbers of breeding pairs and survival of banded birds in the three study colonies. These demographic data may then be analysed in relation to remote sensing data such as sea surface temperature and ocean colour, and with respect to the catch per unit effort of various fisheries.

5 Acknowledgements

This research was funded by the National Geographic Society, the New Zealand Ministry of Business, Innovation and Employment, and NIWA. We thank staff at the Southern Islands Store for their continued efficient and unfailingly help during our times in Invercargill. Thanks also to the staff at the Stewart Island Field Centre for their daily radio skeds. Finally, thanks to Henk and his crew for their cheerful, helpful and efficient assistance and for being such good company while we were on *RV Tiama*.

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