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# White-capped albatross mark-recapture study at Disappointment Island, Auckland Islands. Field season 2018

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Department of Conservation, Conservation Services Programme project POP2017-04 Seabird population research: Auckland Islands 2017-18

# White-capped albatross mark-recapture study at Disappointment Island, Auckland Islands. Field season 2018

Report to Department of Conservation, Conservation Services Programme

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# Executive summary

The white-capped albatross *Thalassarche cauta steadi* is a biennially-breeding seabird endemic to New Zealand. The species ranks highly in assessments of the risk of commercial fisheries to New Zealand seabird populations, but there is some uncertainty around key life-history parameters. The overarching objective of this study is to obtain robust estimates of white-capped albatross demographic parameters.

To estimate key parameters, including adult survival, recruitment and population trends, we established a marked population of breeding birds at Disappointment Island, Auckland Islands (the largest population of white-capped albatross). We report on field work in 2018 to resight banded albatrosses and increase the number of banded birds in the study area. Three years of recaptures are not sufficient for robust demographic rate estimates, but enable some exploratory analyses. To assess how many further resighting visits might be required for demographic rate estimates to be suitably precise, we generate preliminary demographic rates from resightings to date (2015–2018) and use these to simulate realistic 'dummy' resighting data that build on the real data to date.

A total of 521 breeding white-capped albatrosses have been banded in four annual visits to Disappointment Island 2015–2018. A third of white-capped albatross banded in previous years were resighted in 2018, compared to 22% and 23% in the two previous visits 2016 and 2017. These resighting rates are encouraging, given the short duration of visits (insufficient time for incubating birds to be relieved by mates), and given that the primary focus of the work was on banding, not resighting.

Simulation modelling indicated that the accuracy and precision of all estimated parameters incrementally improves with further consecutive resighting years. Using the example of adult survival, we show that the rate of decrease in the variance of survival estimates was greatest with 1–3 further years of consecutive resighting effort from present.

**Keywords:** White-capped albatross, *Thalassarche cauta steadi*, Disappointment Island, mark-recapture, demographic rate, simulation modelling

# Contents

## Introduction

The white-capped albatross *Thalassarche cauta steadi* is a biennially-breeding seabird endemic to New Zealand (Sagar 2016). An estimated 95% of the population breeds on Disappointment Island (Sagar 2016), a 330-ha island in the Auckland Islands group. The species continues ‘At Risk – Declining’ in the New Zealand Threat Classification System (Robertson *et al.* 2013, Robertson *et al.* 2017). Internationally the white-capped albatross is classified as ‘Near Threatened, Declining’ (BirdLife International 2016).

In assessments of the risk of commercial fisheries to seabird populations, such as New Zealand’s Level 2 Risk Assessment (Richard & Abraham 2013), the white-capped albatross ranks highly. White-capped albatrosses are caught as incidental bycatch in commercial trawl and longline fisheries in New Zealand and overseas. An estimated 7,159 white-capped albatrosses were caught in NZ fisheries 2002–2016, mostly in commercial trawl (5,643) but also in surface longline (1,160) and bottom longline (356) fisheries (Abraham & Thompson 2015). The white-capped albatross remains the most commonly caught albatross species in commercial pelagic longline fisheries in South Africa with ~650 killed 2006–2013 or 92 per year (Rollinson *et al.* 2017). This is a massive reduction from the 7,000–11,000 estimated white-capped albatross killed in the two years 1998–2000 (Ryan *et al.* 2002), reflecting substantial regulatory and mitigation changes in these fisheries (Rollinson *et al.* 2017). In South African trawl fisheries, as many as 7,000 white-capped albatrosses are estimated to have been killed annually (Watkins *et al.* 2008). Mortality in high seas fisheries remains largely unknown.

However, the risk ranking of white-capped albatrosses in the 2013 Level 2 Risk Assessment has been debated, mainly because of uncertainty in key life-history parameters. Uncertainty in population size and demographic rate estimates, particularly adult survival, can have a profound effect on the accuracy of risk assessment modelling (e.g. Walker *et al.* 2015).

Estimates of the breeding population of white-capped albatrosses to date are based on interpretation of photographs taken by helicopter in mid-December 2006–2010 and mid-January 2011–2015 (Baker *et al.* 2015). Further photographs of the entire population of white-capped albatrosses on Disappointment Island have been taken since 2015 (e.g. Baker & Jensz 2016) but have not been interpreted, so more recent estimates are not available.

Demographic rates have only been estimated from a small colony on main Auckland Island (Francis 2012). The number of banded breeding birds (122) and resighting visits (four) were fewer than optimal, giving wide confidence intervals (CI) around parameter estimates. For example, adult survival rate was estimated as 0.96, but with 95% CI 0.91–1.00 (Francis 2012). Since survival rates are a key parameter in fisheries risk models and conservation status assessments, obtaining a precise, accurate survival estimate for breeding white-capped albatrosses is a DOC research priority (DOC CSP 2016).

A feasibility study suggested that the large white-capped albatross colony on Disappointment Island would be a good site for a mark-recapture study that could yield quality estimates of demographic parameters (Thompson *et al.* 2015), including population size estimates, trends, and adult survival rates. An overview of the first three years’ work in establishing a marked population can be found in Parker *et al.* (2017). Here, we report on the progress of the white-capped albatross demographic study on Disappointment Island.

### *Aim and objectives*

The long-term aim of this work is to estimate key white-capped albatross demographic rates including adult survival, and to estimate population size and trends. We report on work collecting resighting data at the study colony on Disappointment Island and building the marked white-capped albatross population. We also conducted exploratory demographic assessments using study data from the three years of resighting to date, and simulated data to assess the precision of demographic rate estimates that might be expected with further resighting visits.

## Methods

### *Timing and breeding phenology*

The Disappointment study area visit took place 16–19 January 2018 with four people (authors GP and KRH aided by Kevin Parker and Colin Miskelly). Another two people helped with a final round of resightings on the departure day (Nicki Atkinson and Alan Tennyson).

The timing and duration of the Disappointment Island work was largely determined by the availability of a charter boat in the Auckland Islands for other DOC CSP projects. The egg-laying period for white-capped albatrosses is November to December, incubation is estimated to be 65–75 days and chicks fledge after approximately 115–130 days, between June and July (Sagar 2016). This mid-January 2018 visit thus took place during mid- to late incubation.

### *Study site*

In 2015, a discrete white-capped albatross study area clearly delineated by natural landscape features was selected close to Castaways Bay (Fig. 1) (Thompson *et al.* 2015). The study area location has proven practical, both in terms of albatross numbers and in terms of travel time from the field camp to the study area (Parker *et al.* 2017). It is possible to camp close to the colony; we camped on the spur just above the landing in Castaways Bay, at 50.6058°S 165.9904°E (Fig. 1). The tent footprint from earlier visits was reused to minimise disturbance of vegetation and seabird burrows.

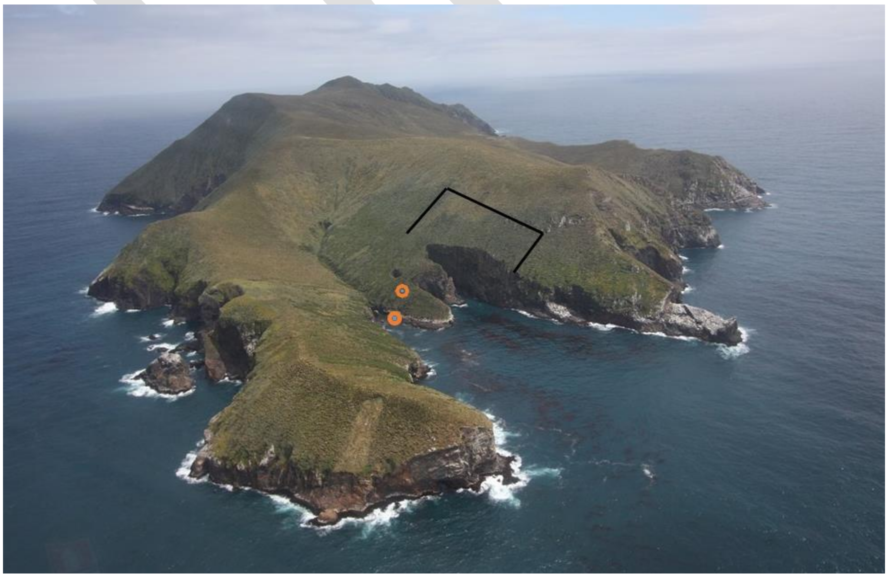

Figure 1. Castaways Bay, Disappointment Island, showing the landing point (lower orange circle), camp-site (upper orange circle), and white-capped albatross study area (inside black rectangle).

### *Banding and resighting*

The main focus of the white-capped albatross work was to band breeding white-capped albatrosses within a well-defined, spatially restricted study area (Fig. 1). Breeding birds were captured on the nest, the egg covered with a fleece hat and the adult removed and leg-banded beside the nest (also see Thompson *et al.* 2015). As in previous years, white-capped albatrosses were banded with a unique metal band on the tarsus, and a white plastic numeric band fitted on the other leg. The nest location of each banded bird was recorded on handheld GPS (Garmin 62s). Nests were not marked in any other way. All birds handled were marked with a small spot of stock marker (Donaghys Raddle) above the bill. As white-capped albatrosses are sexually dimorphic (Double *et al.* 2003), culmen and bill tip measures were taken to determine the sex of banded individuals. Birds were released beside the nest, after scanning the area for patrolling skuas that may attack the egg prior to the parent getting back on the nest pedestal.

White-capped albatrosses are flighty, so handling methods have evolved to minimise disruption to the nest and colony. For example, we used topography to increase the probability of birds settling back onto nests after handling. By selecting birds to be banded from sites that are steep and densely vegetated in the 180° area behind the nest, birds cannot easily escape uphill on release. We found that birds re-settled best when the bird was released ~60cm downslope of the nest, facing its egg or chick, and when light contact with thumb and forefinger on the bird’s wing-tip was maintained. To deter immediate flight, the second person stood with arms outspread opposite the bird handler. On the bird’s release, both people rapidly dropped downhill to minimise their presence as quickly as possible. If the bird immediately made direct eye contact and bill-probing towards its egg or chick, the bird handler released the bird’s wing-tip and both people progressed further downslope, monitoring the birds’ behaviour but staying mostly out of sight. If the bird appeared about to fly, the two people could stand up with arms outstretched to block the bird’s route. This generally slowed the bird enough for it to make a visual re-connection with its egg or chick and climb back onto its nest.

All white-capped albatross nests and loafing birds in the study area and in a 50m buffer were checked for banded birds to collect resighting data, building individual capture histories for capture-mark-recapture analyses.

### *Nest cameras*

To gain insight into breeding parameters including nest survival, hatching and fledging dates, and colony return dates, we set up a nest-camera trial. Wildlife cameras were deployed at three sites in the study colony. At each site, two cameras monitor nests with banded breeding individuals, recording images suitable for time-lapse review.

### *Albatross tracking*

Tracking devices were fitted on white-capped albatrosses in 2016 to better understand their at-sea movements. Forty light-level geolocators were deployed. So far 17 trackers have been recovered, and two birds resighted that have lost their tracker.

### *Simulation modelling*

To assess the precision of demographic rate estimates going forward based on the data to date, we first built a demographic assessment model from the data collected in the study 2015–2018 (real data). Estimates of annual survival and resighting probabilities were then used as input values in a data simulator to generate mock mark-resighting observations (simulated data). Data simulated resightings over 1–6 further consecutive years of effort, where six further visits would give a total study duration of 10 years.

Using capture histories for the 521 white-capped albatross banded to date, we conducted exploratory demographic assessments using package *RMark* 2.24 (Laake 2013) and program MARK (White & Burnham 2009). Several models were tested and estimated parameters did not diverge appreciably, so we settled on the simple Pradel lambda model with default formulas (Pradel 1996). The main parameters of interest estimated were ϕ - apparent survival, or the annual probability of survival, and p – the annual resighting probability.

We simulated data with simHMM in R package *marked* (Laake *et al.* 2013) and then fit the CJS model with *RMark*. A HMM or hidden Markov model was used to generate annual mark-resighting observations, adding a further 130 banded individuals every year (average of the number banded in each of the four visits to date). Data simulated banding and resighting over five years (current study +1 yr, 2015–2019), six years (+2 yrs), seven years (+3 yrs) and 10 years (+6 yrs), given annual survival and probability of resighting from real data. Twenty simulated datasets were generated for each time interval. Outputs from the data simulator were then used to generate estimates of ϕ and p, assuming that demographic rates were constant with respect to resighting year. The time used for rates estimation was the number of years of resighting effort. The mean, SE, lower and upper confidence intervals CI, and coefficient of variation c.v. of parameter estimates are reported for 20 samples of simulated mark-recapture observations.

## Results

### *Banding and resighting*

A total of 521 breeding white-capped albatrosses have been banded in the Disappointment Island study colony (Table 1). Of these, 438 have white plastic bands as well as their metal band (Table 1).

One hundred and thirty banded white-capped albatrosses were resighted over the 3-day island visit in 2018. White-capped albatross resighting rates were 33% in 2018, compared to 22% in 2016 and 23% in 2017 (Table 1).

Table 1. White-capped albatrosses banded and resighted in subsequent years on Disappointment Island 2015–2018.

| | 2015 | 2016 | 2017 | 2018 | Total |
|---|---|---|---|---|---|
| *Metal banded* | 150 | 83 | 160 | 128 | 521 |
| *Plastic banded* [a] *(2015 metal-only birds)* | na | 115 (32) | 183 (23) | 139 (11) | 438 |
| *Resighted from previous years* | na | 32 (of 150) | 56 (of 233) | 130 (of 393) | |
| *% resighted* | na | 21% | 24% | 33% | |
| *Duration of work* | 3 d, including ground-truth | 3 d, including ground-truth | 2.5 d, mark-resight only | 2.5 d, mark-resight only | |

[a] Plastic banded is the total number of individuals fitted with numbered white plastic bands

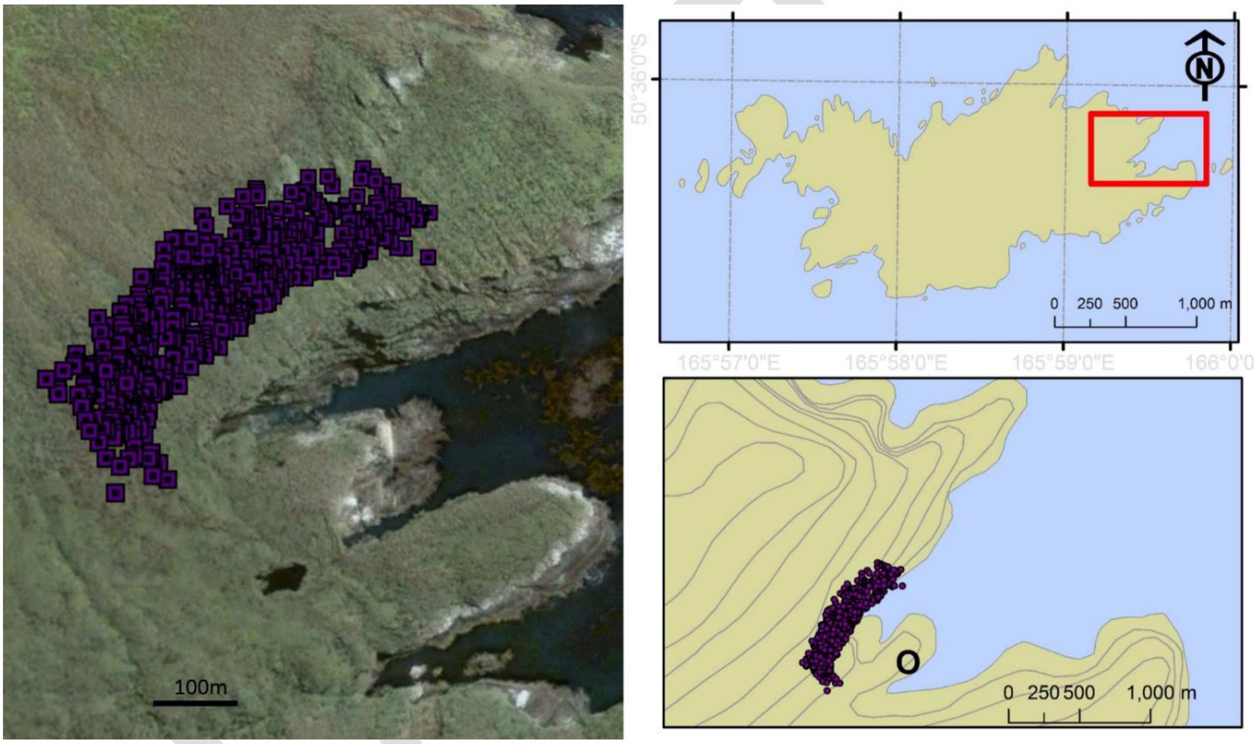

Figure 2. Locations of the 521 breeding white-capped albatrosses banded at Castaways Bay, Disappointment Island 2015–2018

### *Breeding failures*

In 2018, four breeding failures resulted from capture and handling of nesting white-capped albatrosses (2.9% of 139 handled). Most broke the egg on return to the nest, with one case of a skua eating the egg before the adult returned. Similar failures occurred in 2015 (2% of 150 birds) and 2016 (2.6% of 115), also mostly from egg damage when parents returned to the nest (Thompson *et al.* 2015, Parker *et al.* 2017).

In contrast, there were no breeding failures during the one visit that was timed so that birds were brooding chicks. That visit, in 2017, took place early February when 92% of 203 birds handled were at brood-guard stage (Parker *et al.* 2017). Chicks are less vulnerable to damage by parents climbing back onto the nest pedestal than are eggs, and chicks also appear less at risk of skua depredation than eggs.

Four incubating birds abandoned nests after release. All birds returned to the nest, but at one of these nests patrolling skuas had already eaten the egg (included in breeding failures above). Covering abandoned eggs with grass somewhat reduces the risk of skua detection, but eggs are clearly vulnerable to skuas. In contrast, we did not observe any depredation of unguarded chicks by skuas during our February 2017 visit. Chicks also appeared sufficiently large to not suffer obvious effects from exposure.

### *Data simulation*

Exploratory modelling of capture histories from fieldwork 2015–2018 indicated that adult survival ϕ is around 0.92 (95% CI: 0.77–0.97), with estimated resighting probability p being 0.32 (0.26–0.39). Increasing the number of further consecutive resighting years from present led to an increase in the precision of all estimated parameters. Focusing on apparent annual survival, estimates were bounded by progressively tighter confidence intervals over 2–3 further visits (Figure 3). With 10 years of resighting effort, the CI range was quite small (0.81–0.99) (Figure 3).

The rate of decrease in the coefficient of variation of survival estimates was greatest with 1–3 further years of consecutive resighting effort from present, with relatively smaller decreases in c.v. with additional resighting years (Figure 4).

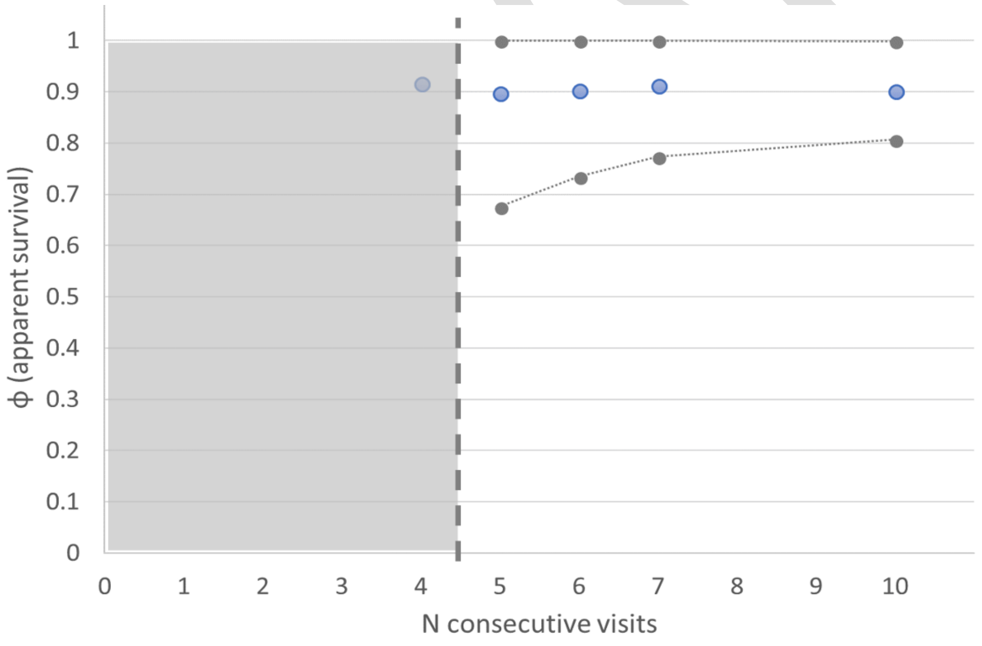

Figure 3. Apparent survival estimates with a further 1, 2, 3, or 6 consecutive resighting years from present (dashed line, year 4), bounded by lower and upper 95% confidence intervals. Capture history number increases by 130 in each interval; n=20 simulation samples per interval. Study period to present indicated in grey box.

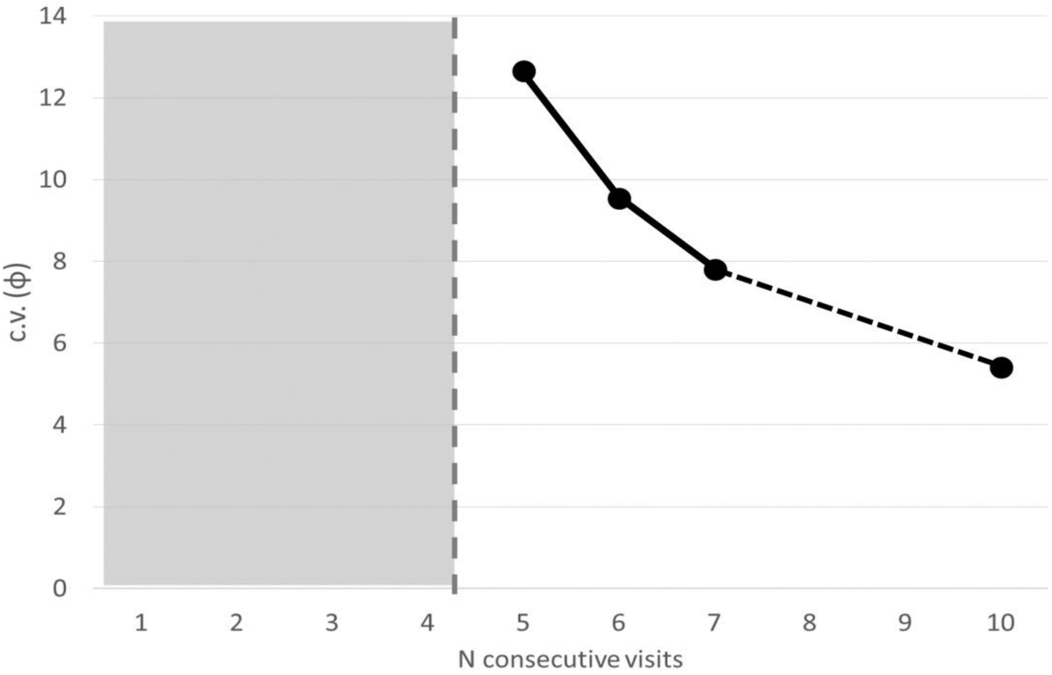

Figure 4. The coefficient of variation (c.v.) of apparent survival estimates (φ) with an additional 1, 2, 3, or 6 further consecutive resighting years from present (vertical dashed line, year 4). Capture history number increases by 130 in each interval; n=20 simulation samples per interval. Grey box denotes study to present.

## Discussion

### *Banding, timing and risk of failures*

A field team of two can band at least 50 white-capped albatrosses in a full work day if conditions are dry enough for bird handling, enabling short visits to Disappointment Island. To allow for suitable boat landing conditions, weather once on the island, and to increase the number of recaptures (see section below), future visits should aim for a minimum of five days on the island, excluding travel time.

Conducting white-capped albatross banding in January during this 2018 season confirmed that it is better to band birds in February than during January, for two main reasons. Most importantly, white-capped albatrosses are challenging to settle back on nest after banding and measuring. We caused breeding failures when handling birds during the incubation period (January this season, also January 2015 and 2016) but not during the brood-guard stage (February 2017). This is because unlike eggs, chicks are not damaged by parents climbing back onto the nest pedestal. During the brood-guard stage, a chick alone on the nest did not attract the interest of skuas (unlike an egg) or appear to be thermally compromised.

Secondly, the duration of parental shifts at the nest gets progressively shorter over the course of incubation in albatrosses and shifts are shortest during the brood-guard period: two days (Torres *et al.* 2011) compared to two weeks or more during mid-incubation (D. Thompson unpublished data).

Thus, resighting rates will be maximised during brood-guard, when it is more likely that both parents will attend the nest during a short study colony visit.

### *Resighting*

A resighting rate of 33% in 2018 is encouraging, building on the 22% (of 150) and 23% (of 233) in 2016 and 2017. These resighting rates are particularly encouraging given the short duration of visits that did not allow sufficient time for mate changeover at the nest, and given the primary focus of the work on banding (not resighting). Visits that focus primarily on resighting, taking place in early February when mate changeovers are most frequent, should be able to increase resighting rates further.

### *Simulation modelling*

Three years of recaptures since the study's start in 2015 do not yet provide enough capture history depth to allow survival estimates for any species (Lettink & Armstrong 2003), let alone for principally biennially-breeding species like the white-capped albatross. This is amply illustrated in our exploratory modelling here; for example, estimated annual survival was 0.92 with 95% CI of 0.77–0.97. Despite being coarse, these preliminary estimates are promising since they broadly align with estimates for white-capped albatrosses from the small Southwest Cape study (0.96, 0.91–1.00) (Francis 2012), and from simulation of 150 birds over five resighting visits (0.95, range 0.91–0.99) (Roberts *et al.* 2015). Our preliminary figures are also in line with those for other *Thalassarche* albatrosses: Buller's albatross estimates ranged 0.91–1 (Francis & Sagar 2012), and Salvin's albatross chick survival was 0.93 (0.68–0.99) (Sagar *et al.* 2015). However, our primary goal in generating these coarse initial estimates was to provide real-world inputs to shape simulations, in order to assess the potential for further consecutive visits to yield useful gains in precision.

Based on banding and resighting in the study colony to date, we simulated further consecutive years of banding effort and associated resighting observations. Our simulation approach indicated that resighting effort over 3–6 further years from present (7–10 consecutive study years total) would be required to produce estimates of demographic rates suitably precise to meet management requirements. This is in line with findings from Roberts et al. (2015), where estimates were most precise by the 10th simulation year.

The simulation approach was kept as simple—but realistic—as possible. We considered the effect of further successive years of resighting effort varying only the banded sample size (progressively increased according to our continued banding effort). Several factors were not accounted for in simulations. Simulation modelling did not include demographic rates varying over time, for example, nor did we account for differing recapture rates for breeding and non-breeding birds. Our simulation outputs should therefore be viewed as a best-case scenario, where more sampling effort may in fact be required than indicated by simulations to account for the effect of varying demographic rates over time and breeding stage. Sampling effort could be increased via more resighting years, but could also be addressed by better resighting effort in a given resighting year (longer visit, or visit timed to February brood-guard stage).

### *Recommendations*

With a substantial marked population of white-capped albatrosses in the Disappointment Island study colony, we suggest further visits can now primarily focus on resighting banded birds, with banding new individuals a secondary aim. To maximise resighting rates and minimise the risk of breeding failures, we recommend further visits be timed to the brood-guard period in early February. Visits should aim for a minimum of five days on the island, to allow for suitable boat landing conditions at dropoff and pickup, and for weather once on the island.

Exploratory analysis and simulation modelling confirmed that in due course, our study will provide robust, precise demographic rate estimates suitable for risk assessments and conservation status monitoring. Although we mostly discuss survival rates here, these mark-recapture methods can be used to estimate population size, record population trends, and allow population viability analyses (Lettink & Armstrong 2003).

We considered the effects of further successive years of resighting effort, together with progressively increasing banded sample size, on the precision of demographic parameter estimation. Simulation modelling suggests that another three to six years of resighting data are needed, instead of the 10 years needed had the marked population remained small (e.g. 150 birds, Roberts et al. 2015).

However, demographic rates in a wild population are expected to vary. This may mean extra resighting effort is required, together with modelling approaches that account for demographic rate variation. In particular, modelling should allow for time-varying demographic rates (particularly for survival, but also population trend), and assess the effect of varying resighting probability by breeding status (resighting probability expected to be greater for breeding than non-breeding birds).

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