The establishment of a marked population of white-capped albatross to allow estimation of adult survival & other demographic parameters, Disappointment Island, Auckland Islands

Graham Parker, Paul Sagar, David Thompson and Kalinka Rexer-Huber

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Graham Parker[1], Paul Sagar[2], David Thompson[3] & Kalinka Rexer-Huber[1,4]

[1] Parker Conservation, 126 Maryhill Tce, Dunedin, New Zealand

[2] National Institute of Water and Atmospheric Research Ltd, P.O. Box 8604, Christchurch, New Zealand

[3] National Institute of Water and Atmospheric Research Ltd, Private Bag 14901, Kilbirnie, Wellington, New Zealand

[4] University of Otago, PO Box 56, Dunedin, New Zealand

*Corresponding author: g.parker@parkerconservation.co.nz

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Executive summary

The white-capped albatross *Thalassarche cauta cauta* is a biennially-breeding seabird endemic to New Zealand. The species ranks highly under the Ministry for Primary Industries Level Two Risk Assessment of the risk of commercial fisheries to New Zealand seabird populations. The survival rates of breeding white-capped albatrosses was estimated from a five-year study at Southwest Cape, Auckland Island. However the Southwest Cape colony is small, and so the number of banded breeding birds and resighting visits were fewer than optimal, giving wide confidence intervals around estimates of adult survival rate. Estimates of the breeding population of white-capped albatrosses to date are based on the interpretation of photographs taken during helicopter flights at the Auckland Islands each year 2006 - 2013.

We established a marked population of breeding adult white-capped albatross at their largest colony on Disappointment Island, Auckland Islands with the long-term aim to estimate key white-capped albatross demographic parameters, including adult survival. The work reported here comprises the set-up phase of a study area established in a dense white-capped albatross colony close to Castaways Bay. To support the interpretation of aerial photographs, an additional objective was to conduct ground-truthing counts to estimate the proportion of breeding white-capped albatrosses from those that are apparently incubating (birds sitting on nests that do not actually have an egg).

A total of 393 breeding white-capped albatrosses have been banded in three annual visits to Disappointment Island 2015 – 2017. White-capped albatross resighting rates of birds banded in previous years were 21% in 2016 and 24% in 2017. Ground-truthing counts of incubating versus apparently incubating birds revealed that overall the proportion of incubating birds averaged 64% from 21 transects.

Two years of recaptures do not provide sufficient recapture histories for individuals to allow survival estimates. However our two short visits in 2016 and 2017 recorded encouraging resighting rates, given the short duration of visits that did not allow sufficient time for breeding pairs to changeover mates, and the primary focus of the work on banding and ground-truthing (not resighting).

Ground-truthing data show that counts of the breeding population of white-capped albatrosses on Disappointment Island using aerial photography cannot provide an accurate or consistent estimate without calibration by ground-truthing data of the number of birds apparently incubating. As the proportion of incubators versus apparent incubators may vary around the island, we question whether sufficient ground truthing data can be collected to enable accurate estimates of the entire breeding population based on interpretation of aerial photography.

Keywords: White-capped albatross, shy albatross, *Thalassarche cauta cauta*, Disappointment Island, population estimate

Introduction

The white-capped albatross *Thalassarche cauta cauta* 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 hectare island in the Auckland Islands group. The remaining 5% of the population is mostly in the Auckland Islands (Adams and Auckland Islands), and then approximately 50 pairs breed on Bollons Island in the Antipodes Islands and occasionally a pair at Pyramid in the Chatham Islands (Sagar 2016). The species is currently classified as 'At Risk – Declining' by the New Zealand Threat Classification System (Robertson et al. 2013) and internationally classified as 'Near Threatened' with the current population trend listed as 'Declining' (BirdLife 2016).

The species ranks highly under the Ministry for Primary Industries (MPI) Level Two Risk Assessment of the risk of commercial fisheries to New Zealand seabird populations (Richard and Abraham 2013). This is because white-capped albatrosses are caught as incidental bycatch in commercial trawl and longline fisheries in New Zealand and overseas. An estimated 8,008 white-capped albatrosses were caught in NZ fisheries 2002 – 2014, mostly in commercial trawl (6,693) but also in surface longline (955) and bottom longline (360) fisheries (Abraham and Thompson 2015). White-capped albatross is the most commonly caught albatross species in commercial tuna fisheries in South Africa with 7,000 – 11,000 killed 1998 – 2000 (Ryan et al. 2002). As many as 7,000 white-capped albatrosses are estimated to have been killed annually in South African trawl fisheries (Watkins et al. 2008), and to an unknown extent in high seas fisheries. The introduction of voluntary measures to reduce the incidental mortality of seabirds in commercial fisheries may have reduced the amount of white-capped albatross bycatch in some fisheries to various extents. A recent NZ review stated that the 2013 Level Two Risk Assessment overestimated white-capped albatross risk ranking due to the low population size used in the risk assessment (Walker et al. 2015).

Estimates of the breeding population of white-capped albatrosses to date are based on the interpretation of photographs taken during helicopter flights at Disappointment Island in approximately mid-December each year 2006 – 2010 and mid-January 2011 – 2013 (Baker et al. 2014). The aerial counts of birds were not calibrated by concurrent ground counts 2006 – 2013 so those estimates of the breeding population were not corrected for the proportion of birds that were 'apparent incubators' when the photographs were taken. Apparent incubators are birds that are sitting on nests without an egg. Ground truthing was conducted during a 30-minute period on Disappointment Island December 9 2008, during which 447 nests 1 m to each side of a transect were checked. It was found that between 12:00 and 12:30 pm, 93.5% of nests had eggs and 6.5% were empty but occupied by an apparent breeder (see Baker et al. 2014). A similar figure was estimated by Baker et al. (2014) from the assessment of 15 aerial close-up photos to provide a correction factor of 5.8% to account for the proportion of 'apparent incubators'.

Results of the 2006 – 2013 estimates from aerial photography taken approximately mid-December to mid-January suggest there has been no clear monotonic decline in the breeding population in that period (Baker et al. 2014). A sharp decline in the number of breeding pairs of the species at Disappointment Island 2007 – 2011 has previously been reported (117,197 pairs in 2007 and 77,005 pairs in 2011) but inter-annual variability and larger numbers apparently breeding in 2012 (100,501 pairs, Baker et al. 2013) questioned the accuracy of that interpretation (Birdlife 2016). Further photographs of the entire population of white-capped albatrosses on Disappointment Island have been taken in the three years since 2013 but these have not been interpreted, and therefore more-recent estimates are not available.

The survival rates of breeding white-capped albatrosses was estimated from a five-year study at Southwest Cape, Auckland Island (Francis 2012). The colony is small, and so the number of banded breeding birds (122) and resighting visits (four) were fewer than optimal, giving wide confidence intervals around estimates of adult survival rate (0.96, CI 0.91 – 1.00) and probability of breeding (0.68, 0.58 – 0.81) (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 Department of Conservation, Conservation Services Programme 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). Here, we report on the development of that study.

Aim and objectives

The long-term aim of this work is to estimate key white-capped albatross demographic parameters including adult survival. The work reported here comprises the set-up phase, with the objectives to establish a marked population of breeding adult white-capped albatross at their largest colony on Disappointment Island, Auckland Islands, and to collect resight data. To support the interpretation of aerial photographs, an additional objective was to conduct ground-truthing counts to estimate the proportion of breeding white-capped albatrosses from those that are apparently incubating.

Methods

Timing and breeding phenology

Three annual visits to Disappointment Island are reported here. The availability of a charter yacht in the Auckland Islands for other DOC CSP projects largely determined when visits to Disappointment Island were conducted. The first visit to Disappointment Island was 31 December 2014 to 11 January 2015, during which three fieldworkers (GP, KRH, PS) spent three days dedicated to white-capped albatross banding; January 6, 8 and 11. Two further, shorter trips followed with two workers instead of three (GP and KRH); a three-day visit 8 – 12 January 2016 and 2.5 days 13 – 16 February 2017.
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). The 2015 and 2016 visits in early to mid-January occurred during mid-incubation. The 2017 visit in mid-February coincided with the peak of the brood-guard stage, with a very small number of albatrosses still incubating and very few chicks no longer guarded by parents.

Study site

In 2015, a discrete study area clearly delineated by natural landscape features was selected (Fig. 1) (Thompson et al. 2015). The study area was established in a dense albatross colony close to Castaways Bay as this is the only location on the island where boat landings are possible. Castaways Bay is also adequate for 1 – 2 small tents. Three visits have confirmed that the site is practical, both in terms of albatross numbers available for study and in terms of travel time from the camp to the study area.

In each of the three visits 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 re-used to minimise vegetation and burrow disturbance.

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

Banding and resighting

During all three visits 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). Each year, white-capped albatrosses were banded with a unique metal band on the tarsus, and from 2016 onwards a white plastic numeric band was fitted on the other leg. Breeding or loafing metal-only birds (from 2015) encountered in subsequent years were recaptured and also given a plastic band. The nest location of each banded bird was recorded on handheld GPS only (Garmin 62s); nest locations 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 the topography in white-capped albatross colonies to increase the probability of birds re-settling on nests after handling. Selecting birds to be banded from nests that are steep and densely vegetated in the 180° area behind the nest means birds cannot quickly and easily escape in that direction. The remaining 180° area around the nest can then be ‘fenced’ by two people when the bird is released. We found birds re-settled best when one person knelt slightly downslope of the nest and released a bird facing its egg or chick, but approximately 60 cm from the nest pedestal, and maintained light contact with a thumb and forefinger on the bird’s wing-tip. To deter immediate escape by the bird in the direction away from the handler, the second person stood with arms outspread opposite the bird handler. On the bird’s release, both people rapidly dropped down slope of the bird to quickly minimise their presence. 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 and into the surrounding vegetation until just enough of their heads were exposed to continue monitoring the birds behaviour. If the bird appeared about to depart the nest the two people could stand up from there, with their arms outstretched to block the birds route. This generally slowed

the bird down enough that it made a visual re-connection with its egg or chick and climbed back onto its nest.

In 2016 and 2017 visits, all white-capped albatross nests and loafing birds in the study area and in a 50 m buffer were checked for banded birds to collect re-sighting data, building individual capture histories for capture-mark-recapture analyses

Ground-truthing

To aid interpretation of aerial photographic estimates, ground-truthing counts of breeding white-capped albatrosses were conducted in 2015 and 2016. To estimate the proportion of breeding, apparently breeding, and non-breeding birds in the colony we conducted transect surveys. As close to the timing of the aerial survey as practicable, each field team member walked slowly and quietly along transects determined by fixed compass bearing. Nests within 2-3 metres either side of the transect line were counted, recording the status of each nest pedestal as:

1. occupied by a sitting bird with an egg / occupied by a sitting bird without an egg

2. whether the nest shows clear signs of a failed breeding attempt; for example, broken eggshell or eggshell fragments

Additionally, we recorded loafing birds: those standing on a nest, and those not on a nest. Not all loafers will be non-breeders: some birds sitting directly next to a nest are likely to be the partner of the bird on that nest, and other birds recorded as loafing may be breeding birds on transit to or from a nest, or birds whose breeding attempt has already failed. Given this variability, we consider that only useful indicator of the number of breeding pairs is birds on a nest with an egg.

In 2015, ground-truthing transects were conducted 6 and 10 January, 4 – 8 days before aerial photographs of the entire breeding area of white-capped albatrosses were taken. In 2016, ground-truthing was conducted at the same time as aerial photographs were taken.

Results

Banding and resighting

A total of 393 breeding white-capped albatrosses have been banded in the Disappointment Island study colony (Table 1). Of these, 298 have plastic bands as well as the metal band. Of the 150 birds banded metal-only in 2015, 55 have now been fitted with plastic bands (Table 1).

White-capped albatross resighting rates were 21% in 2016 and 24% in 2017 (Table 1). Considering the generally biennial nature of breeding in white-capped albatrosses, it is interesting to consider temporal patterns in resightings. Nine of the 150 birds banded in 2015 were resighted in both 2016 and 2017. Of those nine, six were breeding in all three years (annual breeding), and three were recorded as loafing in year two then breeding in year three (biennial pattern expected). Forty-five birds were seen in only 2015 and 2017 (30% of the breeding birds banded in 2015), of which 33 were breeding in both years, and 12 were breeding in 2015 then apparently loafing in 2017. Twenty of 83 (24%) birds banded in 2016 were recorded in 2017. Of these 12 were breeding and 8 were recorded as loafers. These recaptures of 2016 birds in 2017 occurred at the same rate as for all birds banded to date (24%, 56/233).

It is tempting to use these inter-annual patterns of breeding and loafing to suggest breeding success (e.g. breeding then loafing in the following year suggesting the first year's attempt was successful). However, this would be unwise since loafing birds may be active breeders, either arriving at the colony to changeover with a mate or departing the colony after changing over with a mate, or birds that had failed in their breeding attempt earlier in the season, before our visits.

Table 1. White-capped albatrosses banded and resighted in subsequent years on Disappointment Island 2015 – 2017.

	2015	2016	2017	Total
Metal banded	150	83	160	393
Plastic banded[a] *(2015 metal-only birds)*	na	115 (32)	183 (23)	298
Resighted from previous year(s)	na	32 (of 150)	56 (of 233)	
% of marked birds resighted	na	21%	24%	
Duration of white-capped albatross work	3 days, including ground-truthing	3 days, including ground-truthing	2.5 days, banding only	

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

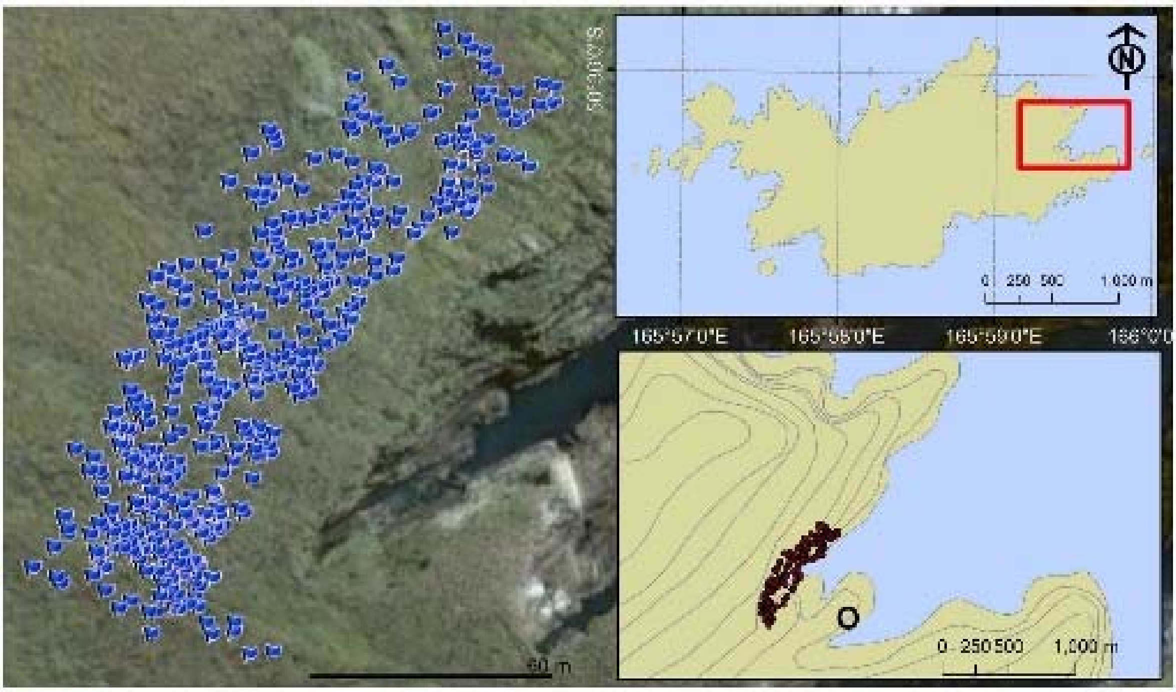

Figure 2. Locations of the 393 breeding white-capped albatrosses banded at Castaways Bay, Disappointment Island 2015 – 2017.

Breeding failures

In 2015 and 2016, capture and handling of incubating white-capped albatrosses caused breeding failures. In 2015 three of 150 birds handled failed (Thompson et al. 2015). One nest failed from a skua depredating the egg after releasing the parent, but before the parent could return to the nest. Two further nests failed because of parents damaging the egg with their bill-tips while climbing back onto the nest pedestal. We caused a further three failures in 2016 (out of 115 birds handled); all three from parents damaging the egg by striking it with their bill tip as they climbed back onto the nest. In 2017, when the birds were almost all brooding chicks, no failures resulted from handling of 203 breeding birds (of which 16 were still incubating eggs).

After we released a bird back to its nest, a small number of both incubating and brooding birds abandoned nests. When this occurred during incubation we covered the egg with grass and departed the immediate area. During the brood-guard stage we simply retreated away from the chick on the nest. Observations showed that in all cases the parent returned to the nest. While eggs are clearly vulnerable to skuas when abandoned, covering the egg with grass seemed to mitigate that risk. We did not observe any depredation of unguarded chicks by skuas. Chicks at the time of our February visit also appeared to be sufficiently large to not suffer any obvious effects from exposure.

The lack of failures caused in the third year is clearly because chicks are less vulnerable to damage by parents climbing back onto the nest pedestal than eggs, but also may at least partly be due to the field team refining their skills. For example, the presence of three field-workers in the first visit did not obviously improve the re-settling rate of birds onto nests after handling compared to visits with just two field-workers (second and third years). Key points for how our handling methodology were refined are summarised in the Methods.

Ground-truthing of aerial counts

Overall, the proportion of incubating birds averaged 64% from 21 transects. The proportion of apparently incubating birds (sitting on nest but no egg) averaging 36%. In 2015, the average number of birds incubating versus apparently incubating in 2015 was 75%, with a median of 77% from 909 nests checked in 8 transects (Table 2). From 560 nests checked in 14 transects in 2016, the average number of birds incubating versus apparently incubating was 57% with a median of 58% (Table 2).

Table 2. White-capped albatross ground-truthing data from 21 transects at Disappointment Island. N with egg, number of birds incubating an egg; N no egg, number of birds apparently incubating but on an empty nest; Total nests, total number of nests with apparently incubating birds in the transect; %, each category as a percentage of total nests; Loafing on nest, number of empty nests with a bird standing or sitting upright; Loafing not on nest, number of birds not associated with a nest.

			Nest with apparently incubating bird					Loafing	
Date	Start time	End time	N with egg	N no egg	Total nests	% egg	% no egg [a]	on nest [b]	not on nest
6/01/15			122	30	152	0.80	0.20	32	17
10/01/15	1000	1020	119	39	158	0.75	0.25	22	20
	1200	1220	113	24	137	0.82	0.18	4	2
	1400	1420	128	13	141	0.91	0.09	3	4
	1600	1620	126	27	153	0.82	0.18	27	20
	1000	1045	100	36	136	0.74	0.26	29	43
	1000	1055	154	33	187	0.82	0.18	59	31
	1248	1308	47	16	63	0.75	0.25	0	9
2015 totals			**909**	**218**	**1127**	**0.81**	**0.19**	**144**	**129**
13/01/16	1036	1048	40	13	53	0.75	0.25	5	12
	1038	1048	40	15	55	0.73	0.27	6	10
	1050	1059	40	13	53	0.75	0.25	4	12
	1051	1102	40	22	62	0.65	0.35	10	11
	1102	1111	40	18	58	0.69	0.31	9	8
	1106	1115	40	16	56	0.71	0.29	6	9
	1117	1129	40	22	62	0.65	0.35	3	18
	1118	1130	40	14	54	0.74	0.26	6	12
	1434	1446	40	13	53	0.75	0.25	6	5
	1439	1447	30	20	50	0.60	0.40	8	10
	1447	1456	17	9	26	0.65	0.35	3	10
	1449	1456	30	13	43	0.70	0.30	4	6
	1458	1511	22	12	34	0.65	0.35	3	11
	1459	1508	30	5	35	0.86	0.14	1	11
2016 totals			**489**	**205**	**694**	**0.70**	**0.30**	**74**	**145**
Overall totals			**1398**	**423**	**1821**	**0.77**	0.23	**218**	**274**

[a] Proportion of birds on nests that are not incubating an egg is calculated as N no egg/Total nests

[b] Loafing on nest are those birds either standing or sitting upright on a nest and clearly not incubating

The time of day affects the proportion of birds on nests incubating but no clear trend is evident from the ground truthing data collected to date (Fig. 3).

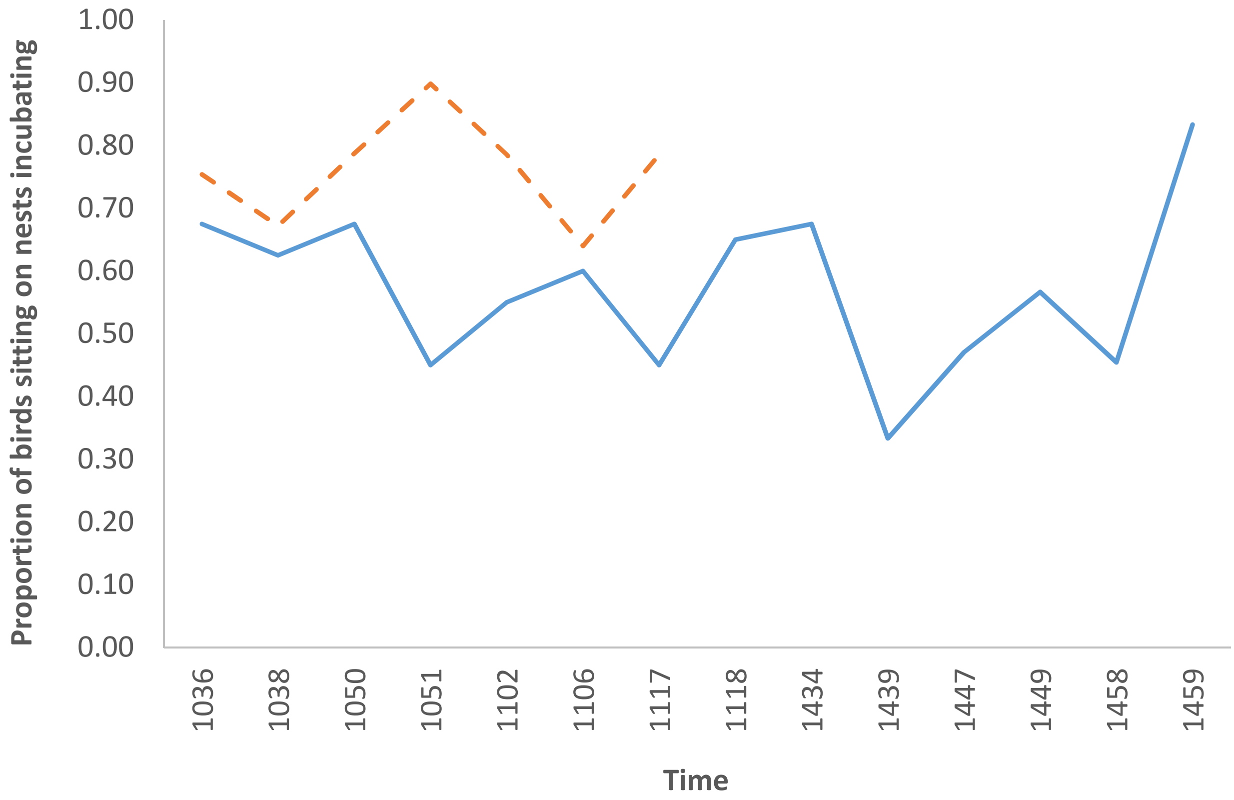

Figure three. Proportion of birds incubating versus apparently incubating 2015 (dashed line, n = 1127) and 2016 (solid line, n = 694).

Discussion

Study site

The approximately two hectare area on the northwest side of Castaways Bay suggested in the feasibility study by Thompson et al. (2015) has proven an easily accessible, practical area to band and resight white-capped albatrosses in sufficient numbers for a robust mark-recapture study. Well established sea-lion tracks through the area provide walking routes that minimise the risk of collapsing petrel burrows. The proximity to the small camp-site minimises travel time and allows the field party to retreat to a tent for shelter during longer periods of inclement weather.

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 the conditions are dry, 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, future visits should aim for a minimum of five days on the island, excluding travel time.

Conducting white-capped albatross banding on Disappointment Island during February was markedly better than during January, for two main reasons. Most importantly white-capped albatrosses are a challenging species to re-settle onto a nest after an individual has been removed for banding and measuring, and sometimes GLS deployment or retrieval. We caused breeding failures when handling birds during the incubation period (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 and at that stage of the brood-guard stage chicks alone on the nest did not attract the interests of skuas 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 is at its shortest during the brood-guard period. Thus, recapture rates will be maximised during brood-guard, when it is most likely that both parents will attend the nest during the resighting period.

A further reason why conducting the work in February is preferable is that in 2016 and 2017, GP and KRH travelled from Adams Island to Disappointment Island in January (only successfully landing on Disappointment in 2016). The five-day absence from Adams Island presented challenges to concurrent work on the Gibson's albatross study. To ensure Gibson's albatross data were not compromised by the team's absence, extended periods of full field days in at times sub-optimal conditions were required to minimise potential gaps in the Gibson's project data.

Resighting

Survival estimates from white-capped albatrosses on Disappointment Island can contribute toward more accurate Level 2 Risk Assessment for this species. The simulation modelling by Roberts et al. (2015) of sample size effects on demographic rate estimation of white-capped albatrosses by mark-recapture found that with a survival rate of 0.95 and a banded population of 150 individuals, the range of survival estimates was wide with 5 years of resighting data. While estimates from 150 individuals became more precise with 10 years of resighting data, estimates from 600 individuals provided the most precise survival estimates with just 5 years of resighting effort (Roberts et al. 2015). Our effort the last two years shows that one further visit to Disappointment Island of at least four good weather days should result in a banded population of more than 600 breeding white-capped albatrosses. Having achieved a large sample size of marked birds just five years of resighting data would be required, rather than the 10 years needed if the marked population was small (e.g. 150 birds, Roberts et al. 2015). It is worth highlighting, though, that in a wild population demographic rates are likely to vary, resulting in the possible need for more resighting data (Roberts et al. 2015). In addition to estimating survival rates, mark-recapture methods can be used to estimate population size, record population trends, allow population viability analyses and highlight knowledge gaps (Lettink and Armstrong 2003).

Two years of recaptures do not provide sufficient recapture histories for individuals to allow survival estimates for any species (Lettink and Armstrong 2003), let alone data collected during short visits of a principally biennially breeding one such as white-capped albatrosses. Therefore we can't yet assess Roberts et al. (2015) findings about how resighting probability affects the precision of demographic rate estimates for breeding birds. Our two short visits in 2016 and 2017 recorded resightings of breeding birds banded in previous years of 21% (of 150) and 24% (of 233), respectively. We consider these resighting rates encouraging, given the short duration of visits that did not allow sufficient time for breeding pairs to changeover mates, and the primary focus of the work on banding and ground-truthing (not resighting). The slightly higher resighting rate in 2017 may be chance, because the banded population was larger (from 150 to 233), or because breeding birds are changing over with mates at a greater rate during the brood-guard stage (two days, Torres et al. 2011) than during mid-incubation period (two weeks or more, D. Thompson unpublished data). Interestingly, of 40 breeding birds fitted with a GLS in 2016, 35% were resighted in the colony over 2.5 days in 2017. Visits that focus primarily on resighting, at a time when the mate changeovers are most frequent, should be able to substantially increase resighting rates.

Ground-truthing

Baker et al. (2014) concluded from an assessment of 15 aerial close-up photographs taken in 2013 that 5.8% of white-capped albatrosses in the colonies were loafers. This is substantially less than the average of 43% (2016) and 25% (2015) we recorded during ground truthing surveys. The 2016 ground-truthing transects were conducted on the same day, at the same time as the aerial photographs taken for that year. Those values allow for correction of estimates made from the photographs taken, but no analyses have been reported to date. Our ground-truthing data show that aerial counts cannot provide an accurate or consistent estimate of the breeding population without calibration of the number of birds apparently incubating by ground-truthing data. As the proportion of incubators versus apparent incubators (that do not actually have an egg) may vary around the island, we question whether sufficient ground truthing data can be collected to enable accurate estimates of the entire breeding population based on interpretation of aerial photography.

Recommendations

A further five-day visit to Disappointment Island would allow the banded population to be increased to more than 600 birds. We recommend that visits to Disappointment Island plan for at least five days on the island and that trips take place during the brood guard stage to (1) minimise or eliminate the risk of causing breeding failures, and (2) coincide with the time when parents change-over nest attendance most frequently.

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