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White-capped albatross population study, Disappointment Island 2024

Parker, G.C., Osborne, J., Sagar, R., Schultz, H., Rexer-Huber, K.

June 2024

Report to Department of Conservation, Conservation Services Programme

DOC CSP project POP2022-08

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Parker G.C.[1]*, Osborne J.[2], Sagar R.[2], Schultz H.[3], Rexer-Huber K.[1]

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

[1.] Parker Conservation, PO Box 2143, South Dunedin, Dunedin 9044

[2.] Department of Conservation, 33 Don Street, Invercargill 9810

[3.] Department of Conservation, Level 1 John Wickliffe House, 265 Princes Street, Dunedin 9016

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Summary

White-capped albatrosses are the most frequently incidentally bycaught albatross species in New Zealand commercial fisheries. The species ranks highly in New Zealand Government risk assessment, with uncertainty around the estimate of adult survival. A white-capped albatross mark-recapture study was established on Disappointment Island in January 2015 to improve estimates of adult survival, and other key population demographic parameters. A 3.5-day research trip to Disappointment Island was conducted 18–21 January; the tenth visit to the island for white-capped albatross survival rate research. Annual survival rates for white-capped albatrosses vary substantially year-on-year, ranging between 0.83 ± 0.06 (± SE) in 2015 to 0.96 ± 0.03 in 2020. Mean annual survival over that period was 0.89 ± 0.04 (excluding the estimate for 2018 which had particularly high variance). Robust estimates of survival and productivity of white-capped albatross require continued visits to Disappointment Island. Banding should be a high priority to ensure the core mark-recapture study is not compromised, since precision of survival estimates is reliant on it. Tracking devices, and cameras to assess productivity, were also recovered and deployed.

Introduction

White-capped albatrosses (*Thalassarche steadi*) are endemic to New Zealand, where approximately 95% of the population breed on Disappointment Island in the Auckland Island group (Baker *et al.* 2014; Walker *et al.* 2020). The species is classified by the New Zealand Department of Conservation as At Risk; Declining (Robertson *et al.* 2021). They are the most frequently incidentally bycaught albatross species in New Zealand commercial fisheries. Edwards et al. (2023) estimate annual white-capped albatross captures in fisheries operating in New Zealand's Exclusive Economic Zone (EEZ) as 2339 trawl captures, 225 surface longline captures and 32 bottom longline captures.

White-capped albatrosses are also still caught in substantial numbers in fisheries off South Africa despite considerable reductions in captures since the late 1990s (Ryan *et al.* 2002; Watkins *et al.* 2008; Francis 2012; Rollinson *et al.* 2017).

White-capped albatrosses ranked highly within the Level 2 Seabird Risk Assessment process (Richard & Abraham 2013; Richard *et al.* 2017; Richard *et al.* 2020), though with a relatively high level of uncertainty around the estimate of adult survival (95% confidence intervals around the survival estimate used in 2013 were 91–99%). To improve estimates of adult survival and other key population demographic parameters, and enable population trend assessment, a white-capped albatross mark-recapture study was established on Disappointment Island in January 2015 (Thompson *et al.* 2015). Short visits to Disappointment Island have occurred for eight of the nine years since (Parker *et al.* 2017; Rexer-Huber *et al.* 2018; Rexer-Huber *et al.* 2019; Parker *et al.* 2022; Elliott *et al.* 2023). Visits were cancelled by the Department of Conservation in 2021 and 2022, but private funding enabled a data collection trip in the latter year.

White-capped albatrosses still rank highly in the most recent Fisheries New Zealand update to the risk assessment for New Zealand seabirds (Edwards *et al.* 2023).

During the breeding season (November–June) white-capped albatross occur throughout waters off coastal New Zealand, especially from Cook Strait south, and across the Tasman Sea to south-east Australian waters. After breeding most birds remain in Australasian waters, but about 20% of adults migrate across the Indian Ocean to seas off South Africa and Namibia (Sagar 2013). Knowledge of the at-sea range of white-capped albatross (gathered by Thompson & Sagar 2008; Thompson *et al.* 2009; Torres *et al.* 2011; Goetz *et al.* 2022) has been supplemented since 2015 by geolocator dataloggers attached to birds breeding in the Disappointment Island study area.

In the Conservation Services Programme Annual Plan 2023/24, the following two objectives within POP2022-08 are relevant to white-capped albatrosses, and therefore the 2024 visit to Disappointment Island:

1. To monitor the key demographic parameters of Gibson's albatross and white-capped albatross to reduce uncertainty or bias in estimates of risk from commercial fishing.

2. To describe at-sea distribution of Gibson's albatross and white-capped albatross.

These POP2022-08 objectives were adapted to the following trip objectives:

- Collect white-capped albatross band resight data from the established study colony to contribute to analyses of white-capped albatross adult survival.
- Retrieve geolocator loggers from adults in the study colony that were deployed in February 2023, and deploy additional geolocator loggers on breeding adults within the study area to contribute to analyses of white-capped albatross at-sea distribution.
- Collect 10 time-lapse cameras deployed in February 2023 and deploy 10 replacement cameras to contribute to analyses of breeding success.
- Survey accessible areas of Disappointment Island for Gibson's albatross nests to contribute to whole population estimates being undertaken in summer 2023/24 at the Auckland Islands.
- Continue developing and improving drone counting methodologies in preparation for future full-island counts.

Methods

Timing

A seven-day period was scheduled for white-capped albatross demographic research on Disappointment Island, beginning approximately on 12 January. Due to conditions (weather and sea state), the trip duration was reduced to 3.5 days 18–21 January (Table 1), when white-capped albatrosses are in the incubation stage of their nesting cycle.

Mark-recapture study

Resightings of banded white-capped albatrosses were collected at the study colony in Castaways Bay on Disappointment Island (Fig. 1). To resight previously banded birds, the study area was visited on three occasions and exhaustively searched for white-capped albatrosses (12 people hours during afternoon to evening on 18/1/24, 15 people hours during morning to early afternoon on 20/1/24 and 4.5 people hours during morning to midday on 21/1/24). Surveys were undertaken by 2 or 3 personnel, each working adjacent longitudinal strips in the study area (Fig. 1). All white-capped albatrosses in the study area (breeding birds on nest and loafers, i.e. birds not on a nest) were checked for bands. Once a bird's band number and breeding status had been recorded, all were marked with stock marker across the breast, so the bird was not disturbed further. Because white-capped albatrosses are flighty and prone to nest abandonment, extra care was taken when checking band numbers and moving around the colony (i.e. moving slowly and only approaching nesting birds from the front). A buffer of ~50 m around the study area was checked in case banded birds had moved outside the study area. No new birds were banded to add to the study since the on-island team were not qualified for albatross banding.

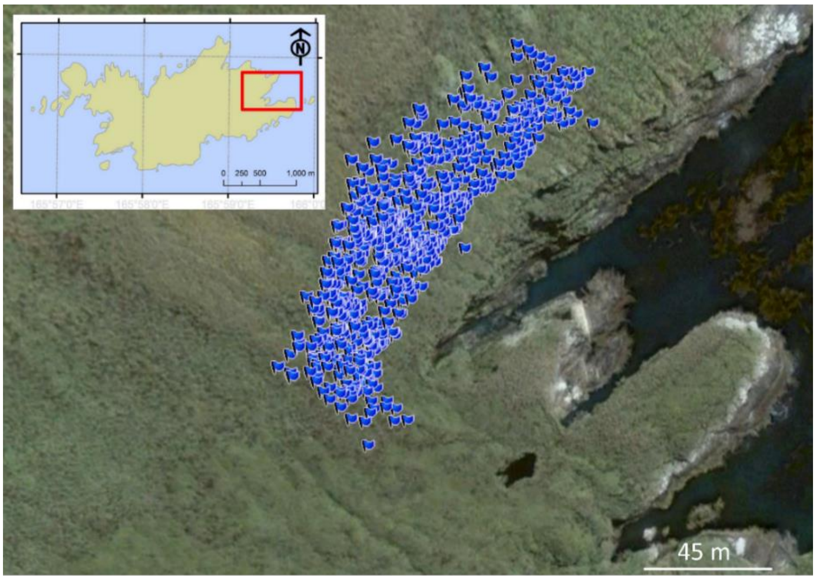

Figure 1. White-capped albatross study area in Castaways Bay, Disappointment Island. Blue flags are banding locations of white-capped albatrosses 2015 to present.

Mark-recapture analysis

The survival of banded birds was estimated using multistate models (Brownie *et al.* 1993) which can estimate separate survivorship and detectability by state. For white-capped albatrosses the two observed states are S birds sitting on a nest with egg or chick, and L birds standing in the colony whose breeding status is unknown. We expect that birds in each of these classes will have quite different probabilities of being seen on the island but similar survival rates. Multi-state survival analysis was carried out using RMark (Laake 2013), the same methods as used for previous white-capped albatross survival analyses from Disappointment Island (Parker *et al.* 2022; Elliott *et al.* 2023). We first tested a range of models for best fit, comparing models using AICc. Specifically, we created models where detection probability varied by state and/or time, and tested whether:

- survivorship differed for every year and state (breeding or loafing);
- survivorship differed between years, but the same for the two states;
- survivorship was constant between years and states.

Annual survival was then estimated using the best-fitting model. There was no field visit to the island in 2021, so survival has not been estimated for that year.

Geolocator collection and deployment

In February 2023, 26 geolocator loggers were attached to the metal bands on adult white-capped albatrosses (24 breeding and 2 non-breeding), all captured within the study area (Elliott *et al.* 2023). Seven of these birds were recaptured in January 2024 and their geolocators retrieved. Six of these birds were non-breeders and one was sitting on an egg. Feathers for genetic sexing were collected of four of these birds.

Thirteen geolocators were attached to the metal bands of breeding white-capped albatrosses found within the study colony area. To do so, birds were caught by hand at the nest, and a geolocator attached to the birds metal leg-band with two high-quality steel lugged cable ties. This method has been used on albatrosses in New Zealand since 2009.

Nest cameras

In February 2023, ten trail cameras mounted on waratahs and set to take hourly time lapse photos, were deployed to capture breeding success (Elliott *et al.* 2023). These cameras were removed and ten new cameras, also set to hourly time-lapse, were deployed in the same position, though some were rotated slightly for better coverage. A photo of the field of view for each camera was captured, recording if birds in the field of view were breeding or loafing (Fig. 2). Cable ties were added to the tops of cameras to help birds see them and avoid hitting them in flight. Most of the previous season's waratahs/cameras had slumped a little from their original placement, though only one was significantly slumped, so all waratahs were propped up with two additional fencing standards to reduce slumping. Some waratahs had large flakes of rust coming off them but should still be effective for another 3–5 years.

Figure 2. Example field-of-view of time-lapse nest cameras in white-capped albatross colony. Active nests visible in field-of-view of each camera circled

Results

Mark-recapture study

Overall, this dataset comprised 667 birds banded 2015–2023 (Table 1). A total of 201 unique resights of banded white-capped albatrosses were recorded during the three rounds of the study colony on Disappointment in January 2024 (Table 1). No obvious nest failures occurred because of human activity in the colony.

Table 1. White-capped albatross banded and re-sighted on Disappointment Island 2015–2024.

	2015	2016	2017	2018	2019	2020+	2021	2022	2023	2024
Banded 667 (703*)	150	83	160	128	122	0	0	0	24	0
Resighted from previous years		32	53	130	191	175	-	173	159	201
Estimated p (95%CI) ‡		0.27 (0.20–0.36)	0.29 (0.23–0.36)	0.42 (0.37–0.48)	0.44 (0.40–0.49)	0.36 (0.32–0.42)	-	0.39 (0.34–0.45)	0.36 (0.31–0.41)	na
Duration of trip (days)	3	2.3	2.3	2.5	2.5	1.5	-	2	4	3.5
Timing	31 Dec–11 Jan	8–12 Jan	13–16 Feb	16–19 Jan	5–7 Feb	21–23 Jan	-	15–16 Feb	11–15 Feb	18–21 Jan

*Total banded when 36 birds banded in the study area in 1993 and 2008 are included

+ land-slip through study area in late 2019, killing some birds & removing white-capped albatross nesting habitat

‡ Detection probability p estimated from model S(~time)p(~time)

A range of mark-recapture models for white-capped albatrosses were compared using AICc. White-capped albatrosses in the colony are seen in different states (S sitting on egg or chick; L loafing or standing in colony). The best supported multi-state model showed that survival rate differs over time, with resighting probability differing between states and over time, and the probability of transitioning from one state differs between states and over time (model 1 in Table 2). There was less support for survival being constant over time (which until this season has been the best model, Parker *et al.* 2022; Elliott *et al.* 2023), and less support again for differentiating the survivorships of breeding and loafing birds (models 2 and 3, Table 2). Observed state is important for white-capped albatrosses survival estimation: resighting probability varied with state in the three top model candidates; models where detection probability does not account for state had much less support.

Table 2*. Model selection table for the top three models of white-capped albatross survival. All three models have detection probabilities and transitions that vary with both state (loafing/nesting) and time [p(~stratum * time)Psi(~-1 + stratum:tostratum:time)]; models where detection probability does not vary by state had less support and are not shown.*

Model	npar	AICc	ΔAICc
1. Survival varies with time	40	5639.28	0.00
2. Survival constant	33	5643.21	3.93
3. Survival varies with time and state (loafing/nesting)	48	5647.84	8.56

Estimates from the best-supported model, accounting for the differing resighting probabilities of states, give white-capped albatross annual survival as ranging between 0.83 ± 0.06 (± SE) in 2015 to 0.96 ± 0.03 in 2020 (Fig. 3, Table 3), averaging 0.90 ± 0.04. However, it is worth treating the estimate from 2018 with caution, as its variance was particularly high (95% CI 0.6–1.0; Fig. 3). The cause of this unusual variance is unknown; the consequence that we can have less confidence in the 2018 adult survival estimate. We have more confidence in estimates from 2015–17 and 2019–20. Considering just these years with more-precise estimates, mean annual survival was 0.89 ± 0.04.

More-recent annual survival estimates are not yet useful: the lack of data from 2021 means the 2022 estimate is of poor quality, and we do not show the 2023 estimate since the most recent survival estimate for biennially to semi-biennially breeding species tends to be poor.

Table 3. *Estimated annual survival, with one standard error, for white-capped albatrosses at Disappointment Isl from field visits 2015 to 2024. There was no research visit in 2021. The 2023 estimate is omitted since mark-recapture estimates for the most recent year of data are not accurate and precise enough to be useful*

Year	Survival estimate	Standard error
2015	0.826	0.056
2016	0.897	0.053
2017	0.865	0.034
2018	0.979	0.036
2019	0.884	0.046
2020	0.956	0.027
2021		
2022	1.000	0.000

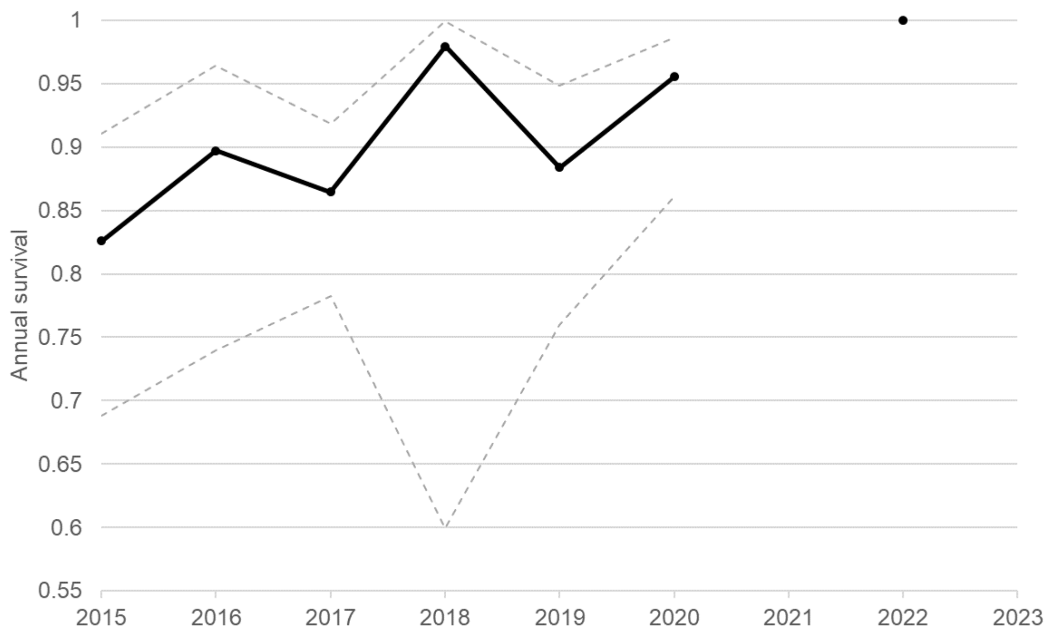

Figure 3. Annual survival of white-capped albatrosses at Disappointment Isl. Survival rate estimates are black dots and bold black lines; variance estimates (upper and lower 95% confidence intervals) are grey dashed lines. There was no research visit in 2021. Mark-recapture estimates tend to be poor for the most recent year of data so the 2023 survival estimate is not shown

Nest cameras, trackers

GLS data recovered will be analysed elsewhere. Similarly, camera data are being used to produce statistically robust daily survival rates as part of a University of Otago Master of Science student's collaboration with the Department of Conservation, so we do not report on interpretation of camera data here.

Other objectives

The reduced trip duration did not allow time for the two final objectives, Gibson's albatross counts and drone trials for whole-island coverage.

Discussion

Annual survival rates for white-capped albatrosses vary between 0.83 and 0.96 over the period 2015–2020, excluding an estimate with particularly high variance from 2018. More recent estimates remain masked by the effect of data missing from 2021 (no research visit) and by the most recent year's estimate being unreliable for semi-biennial to biennially breeding species.

Until this season we have not been able to estimate annually-varying survival rates, instead settling on models that held survival rate constant (Parker *et al.* 2022; Elliott *et al.* 2023). The study is now large enough (and has at last been going long enough) for useful, reliable annually-varying survival rates, provided the banded population is maintained. Although more recent annual survival estimates remain obscured here, data from the 2024 season is expected firm up the estimate for 2023.

Albatross survival estimates tend to vary notably between years (Véran *et al.* 2007) as seen here for white-capped albatrosses. Since natural mortality is smoothed to near-constant over long lifespans, producing low variability in survival across years (Converse *et al.* 2009), spikes and troughs in survival rates over time presumably reflect additional mortalities like those from fisheries bycatch which are unlikely to occur at a steady rate.

Over the period 2015 to 2020, mean annual survival rates for white-capped albatross were 0.89 ± 0.04. A survival rate of less than 0.90 is considered low for an albatross (Véran *et al.* 2007). At subantarctic Marion Island an estimated grey-headed albatross survival rate of 0.951 ± 0.006 was considered possibly sufficient for population stability (Converse *et al.* 2009), based on demographic data showing a stable grey-headed albatross population over a 10+ year period there (Nel *et al.* 2002; Ryan *et al.* 2007). Whilst this example of grey-headed albatross survival rates is insightful, direct comparisons aren't possible because grey-headed albatrosses are near obligate biennial breeders (Prince *et al.* 1994; Waugh *et al.* 1999; Ryan *et al.* 2007), whereas Francis (2012) reported the probability that a white-capped albatross that bred in one year would also breed in the next year to be 0.63, and the probability that a bird that didn't breed in one year but which would breed in the next year was 0.75.

Earlier white-capped albatross survival estimates were higher but less precise: estimated average survival from South West Cape on the main Auckland Island for the four years 2005 to 2009 was 0.96 (95% CI 0.91–1.0) (Francis 2012). This is directly comparable to later point estimates, in using the full resighting dataset available to estimate average annual survival. Average annual survival over the period 2015 to 2022 was 0.89 (0.86–0.91) and for 2015 to 2023 the average was 0.92 (0.90–0.93) (Parker *et al.* 2022; Elliott *et al.* 2023). It would be unwise to ignore the potential that white-capped albatross survival has indeed dropped 4–7% since the late 2000s, but the relatively large confidence intervals of earlier estimates mean comparison is difficult. Both Baker *et al.* (2023) and Walker *et al.* (2020) indicated a decline in white-capped albatrosses at Disappointment Island, albeit at different rates.

CSP Project POP2022-08 has one further Disappointment Island visit to resight white-capped albatrosses scheduled for January 2025. Data from that trip will be very helpful to gauge the direction of survival trends, now that sufficient annual resighting data has been collected to produce robust estimates.

Recommendations

- Robust estimates of survival and productivity of white-capped albatross require continued visits to Disappointment Island. Banding should be a high priority to ensure the core mark-recapture study is not compromised, since precision of survival estimates is reliant on it. This requires that annual trips be longer, to allow for thorough resighting effort and banding to maintain the banded population, as well as time for other objectives (e.g. nest cameras, trackers, Gibson's albatross counts, drone trials for whole-island coverage).
- Annual nest counts could be reinstated to complement annual survival data. We recommend coverage of the wider Castaways Bay colony via drone photography each year, with nests later counted in orthomosaics. This would be more repeatable and reliable than ground counts within the mark-recapture study colony, since the study colony boundaries are difficult to mark (and therefore keep consistent over time) due to the nature of the site. Importantly, nest-contents data can readily be collected during rounds for band resightings at the same time as drone overflight, so raw counts from orthomosaics can be corrected for the proportion of birds on nest that are not breeding. Drone photography would require an extra field day be built on top of the time required for the core mark-recapture work.
- The optimal time for mark-recapture study is early February when mate changeovers are most frequent (maximising resighting rate). Another factor is that desertion due to disturbance of adults is rarer during the chick guard stage than during incubation.
- Work time required must have a substantial weather contingency built around it, since in most years weather has affected sea state at the landing, greatly reducing the time available for core work (and often removing any chance for work on additional objectives).

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