Draft Annual Report

Conduct a population and distributional study on white-capped albatross at the Auckland Islands
POP 2005/02

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Report prepared for the Conservation Services Programme, Department of Conservation

June 2006

Summary

South West Cape, main Auckland Island, was identified as the study site at which to undertake population and distributional studies of white-capped albatross, and was visited during January-February 2006 by a four-person field team to initiate studies.

Three factors hindered the success of the project. 1. feral pigs, present throughout much of the colony, negatively impacted breeding success by disturbing accessible nesting adults, destroying nest pedestals and probably taking eggs and chicks: 2. many nesting birds which were inaccessible to feral pigs were, in a practical sense, also inaccessible to the field team: 3. the majority of birds responded negatively to capture and handling, and in several cases resulted in nests with eggs or chicks being temporarily abandoned.

Population studies were limited to population estimates and limited marking of breeding adults and their nests.

At-sea distributional studies were successful. A total of 31 breeding adults were tracked over 49 foraging trips, with an additional two tracks by a bird post nest failure, using satellite telemetry and GPS technology. Generally, birds did not forage far from the archipelago, with an area to the south and east of South West Cape identified as the most important during the guard stage of the breeding season.

A further 18 breeding birds were tagged with light-based geolocators, with the aim of recording post-breeding movements over relatively large temporal and spatial scales.

1. Introduction

In New Zealand, white-capped albatross *Thalassarche steadi* breed primarily at the Auckland Islands archipelago (Auckland, Adams and Disappointment Islands), with relatively small numbers breeding at Bollons Island, Antipodes group, and at the Forty-Fours, Chatham group (Robertson *et al*. 1997, Tennyson *et al*. 1998, Taylor 2000). Despite being New Zealand's most numerous breeding albatross with ca. 75,000 pairs at the Auckland Islands (Gales 1998), very little is known of breeding biology, population characteristics and demography, and at-sea distribution of this species. Additionally, relatively large numbers of white-capped albatross have been killed and returned from observed New Zealand fisheries (e.g. Robertson *et al*. 2004). This combination of paucity of biological information and relatively high incidence of capture in commercial fisheries has resulted in white-capped albatross being classified as 'high priority' for research in the draft National Plan of Action – Seabirds Research Plan.

This report summarises work undertaken to date as part of the Conservation Services Programme project POP2005/02 - Conduct a population and distributional study on white-capped albatross at the Auckland Islands. The overall objectives of the project were (1) to estimate population parameters relevant to fisheries-related mortality of the white-capped albatross, and (2) to investigate the at-sea distribution of the white-capped albatross particularly as it relates to fisheries.

An initial period of fieldwork was carried out during late January-mid February 2006, corresponding with the hatching and guard (chick-brood) stages of the breeding season. The field team comprised David Thompson (NIWA, Wellington), Graeme Taylor (Department of Conservation, Wellington), Stuart Bearhop (Queen's University, Belfast, UK) and Stephen Votier (University of Plymouth, Plymouth, UK).

2. Study Site

Through a process of discussion with the Department of Conservation (DoC), particularly Southland Conservancy, South West Cape, main Auckland Island was identified as the study site for this project. The reasons for this selection were as follows: although Disappointment Island holds by far the largest population within the archipelago with ca. 72,000 pairs (Gales 1998), or ca. 96% of the total New Zealand population, DoC have classified Disappointment Island as a 'minimum impact' island, based on its near-pristine nature and lack of any introduced mammalian predators. Entry to such islands is strongly limited. Adams Island is similarly classified as a 'minimum impact' island and in any case supports perhaps only ca. 100 pairs (K. Walker cited by Gales 1998) of white-capped albatross at a site with difficult access. South West Cape on main Auckland Island supports ca. 3,000 pairs (C.J.R. Robertson cited by Gales 1998), but unlike both Disappointment and Adams islands, Auckland Island is classified as a 'refuge' island. The island is relatively modified, with extant populations of feral pigs, cats and mice. Furthermore, landing at the South West Cape area is relatively straight forward, and very unlikely to be limited by sea and weather conditions as would be the case for Disappointment Island. DoC was opposed to the establishment of a potentially long-term study on white-capped albatross at Disappointment Island. Given that the population size of white-capped albatross at South West Cape was relatively large compared to the number of breeding pairs required to undertake demographic work, coupled with the status of main Auckland Island, South West Cape was selected as the study site. The relative locations of South West Cape, Disappointment Island and Adams Island within the Auckland Islands archipelago are shown in Figure 1.

2.1. Access to breeding birds

At South West Cape, breeding white-capped albatross are located on ledges and fairly level platforms, spread along several kilometres of cliffs and steeply-sloping terrain. The largest concentration of nests is within an area of sloping ground to the north of South West Cape, bounded to its landward side by vertical rock faces approximately 40m high. To seaward, the breeding slope is bounded by another vertical rock face which falls away to the sea below. This area of breeding birds proved unsuitable for the regular access necessary during a long-term population study, despite exhaustive searches along the landward cliff top and the use of ropes to secure exploratory excursions down the more likely slopes and faces towards the birds below.

Access to and from this area of relatively large numbers of breeding birds would be theoretically possible, but would involve rock climbing of a technical nature. We consider such an approach to be excessively dangerous and high-risk given the perpetually greasy and wet condition of the rock, the relatively shallow soil structure above the cliff and on ledges, which rendered the soil prone to 'sliding off' the underlying rock, and the generally inclement weather characterised by high winds and mist. As a site for a study population, requiring regular access, this area would be unsuitable.

Elsewhere within the South West Cape area, birds were either similarly inaccessible on ledges or slopes down precipitous cliffs, in relatively small numbers (a few tens of pairs) in a very small number of areas that were accessible to us, but inaccessible to pigs (see below), or in areas with relatively easy access, but which were also, therefore, accessible to pigs (see below).

2.2. Pigs

Feral pigs were seen on a daily basis in all but the most inaccessible parts of the white-capped albatross colony at South West Cape. Vertical slopes and bluffs of at least 1m high appeared to act as a barrier to pigs, but their ability to navigate steep and treacherous terrain was surprising. The presence of pigs throughout large areas of the colony was a major limiting factor in the success of this project (but see also notes on the responses of birds to handling described below). Of nine study nests at which tracking devices were deployed on birds and which were accessible to pigs, at least five, probably six, lost small chicks, and in some cases had entire nest pedestals destroyed, as the result of pig activity.

3. Data Collection

3.1. Limitations

In addition to restricted or impracticable access to relatively large, pig-free areas of the colony at South West Cape, and the deleterious effects of pigs (see above), the responses of the birds when approached or handled also posed major problems. Nearly all birds responded negatively to capture (by hand) and handling for banding or the application of tracking devices. Responses ranged from birds taking several minutes to 'settle' back on the nest following release (all birds were placed on the edge of a nest pedestal following handling as early 'trials' revealed that birds released close to the nest were unlikely to climb back onto the pedestal), leaving the nest pedestal completely, leaving the nest and attempting to fly away or actually flying away from the nest site for periods ranging from a few minutes to approaching two hours. In an extreme case, one bird flew away from its nest and chick even though field workers had only approached to within approximately 15 m of the nest site. When birds flew away from the colony after handling, exposed chicks could easily be preyed upon by patrolling brown skuas. In all cases where chicks or eggs were temporarily abandoned by adult birds, field workers remained near the nest to ensure skuas were unable to prey upon nest contents until birds returned. All birds that responded in this way eventually returned to the nest and continued incubating or guarding the chick.

In the majority of cases, handled birds had to be 'corralled' by two or three field workers around the nest site in order to encourage the bird to stay. Only when the bird showed signs of settling back onto the nest could the field workers corralling the bird retire with confidence that the bird would not fly away. Furthermore, capture and handling of a bird caused disturbance effects to ripple out among adults attending neighbouring nests.

In short, white-capped albatross appears to be a species that responds particularly badly to handling. In the light of the range of responses exhibited by handled birds, and the potential for these to effect not only the current breeding attempt but other population measures of interest in ways that would be difficult if not impossible to quantify or control for, the field team decided not to pursue large scale colour-banding of breeding birds.

3.2. Population parameters

Based on counts from vantage points on land, usually overlooking nesting birds from above, we estimated a breeding population of 3,200 pairs during the guard stage (including a small proportion of nests still with eggs) in mid-February, 2006. Additionally, we estimated that of all nests, approximately 20% were well-constructed and 'useable' pedestals (as opposed to obviously small pedestals under construction or damaged pedestals), but were empty at this stage of the breeding season, suggesting a breeding population of perhaps closer to 3,800 pairs during incubation. These numbers fall between the two previous estimates for this colony of 4,000 in 1972/73 (Robertson 1975) and 3,000 pairs in an unspecified year (C.J.R. Robertson cited by Gales 1998). Pig-free sub-colonies have been identified and defined with reference to obvious physical boundaries or markers, combined with digital photographs, and afford the opportunity to monitor population changes in the future.

Although colour banding and nest marking of relatively large numbers of breeding birds was not undertaken (see above), all breeding birds handled were banded with uniquely numbered metal bands and their nest locations recorded and marked with metal pegs and plastic, individually-numbered tags. In total, 65 breeding adults were banded.

3.3. At-sea distribution

Three different devices were deployed in order to gather at-sea distributional data for white-capped albatross. Two of these were data-logging devices and required, or will require, recapture of the bird, device retrieval and data downloading: global positioning system (GPS) loggers (Earth & Ocean Technologies, Kiel, Germany; 'GPSlog' tags, ca. 65 g or ca. 1.6% of body mass) and light-based geolocators (British Antarctic Survey, Cambridge, England; 'Micro Logger', ca. 4.5 g or ca. 0.1% of body mass). The third type of device was a platform transmitting terminal (PTT), positional data being automatically received via orbiting satellites (Sirtrack Ltd., Havelock North, New Zealand; 'KiwiSat 202' PTT, ca. 34 g or ca. 0.9% of body mass).

3.3.1. Device configuration and deployment

A total of 12 KiwiSat PTTs and 20 GPS tags were deployed on birds guarding chicks. Devices were attached using Tesa tape and fixed to contour feathers along the mid-line on the dorsal surface of the bird, slightly posterior of the wings. The PTTs were originally configured for deployment on penguins, and were programmed with a repetition rate (transmission rate) of 40 seconds and continuous operation with no duty cycle. The GPS loggers were programmed to obtain a location every three minutes. Before release, each bird was marked individually on the breast with marker pen as a means of identifying when the bird had been to sea to forage – the markings faded with immersion in sea water. Additionally, the presence or absence of each bird at its nest was recorded as frequently as practicable. Devices were removed as soon as a bird returned from a foraging trip with the aim of deployment for a single trip per bird. For some birds, recapture occurred after two, rarely more, foraging trips. Device attachment and retrieval took less than five minutes per operation. GPS tag data are relatively accurate, to within a few metres, whereas PTT data tend to be accurate to a few hundreds of metres, at best, but more typically on the order of kilometres.

Of the 12 PTTs deployed, 11 were successfully retrieved and all 12 transmitted data. The single device that was not retrieved was on a bird with a nesting attempt that failed ca. five days following deployment of the PTT, for unknown reasons, but which were unlikely to be human-induced as the nest was guarded by the bird's partner for a minimum of four days following device deployment. Of the 20 GPS tags deployed, 19 were retrieved and data successfully downloaded. The single device not recovered was deployed on a bird whose nest was destroyed by a pig four days after deployment. This bird was not observed again at the colony despite an attempt to reconstruct the nest pedestal.

A total of 18 light-based geolocator tags were deployed. Daily positions are calculated from ambient light level readings with reference to time and date – latitude from day (night) length and longitude from the time of local midday (midnight) relative to Greenwich Mean Time. Positional accuracy is much less compared to PTT or GPS devices, perhaps to within 150-200 km, but devices can log data over relatively long periods (years) and can additionally record ancillary data – proportion of time spent on the sea's surface in the case of the BAS 'Micro Logger' tags. Geolocation is the ideal approach to record relatively long-term and long-distance movements, such as migration pathways. Geolocator tags were attached to the bird's leg using a custom-designed plastic tag holder and leg strap; the attachment required no glue, tape or cable ties and was 'self-locking', each deployment taking a minute or so. The aim here is to recover the geolocation tags after a deployment of at least one year .

3.3.2. Distributional data

Table 1 summarises data acquired from PTT and GPS devices. In the case of PTT data, location information acquired through the Argos system is first filtered to remove unrealistic or inaccurate fixes. The filtering process followed that outlined in BirdLife International (2004). The bird's velocity was calculated at each uplink, and the point discarded if the velocity exceeded 100 km hr^{-1}, except where a point had an Argos location quality of 1, 2 or 3, the locations with the highest levels of accuracy (ca. 350 m to 1 km).

Table 1. Summary information for PTT and GPS deployments.

Device	Number deployed	Number of tracks	Total duration of tracks (hrs)	Number of locations	
				Unfiltered	Filtered
PTT	12	26*	1510.3	2332	1840
GPS	20	25	1086.9	20087	

* includes two tracks by the same bird post nest failure.

Filtering resulted in approximately 21% of all locations being discarded, a higher figure than reported from other studies (e.g. 2.4% of locations from a wide range of studies: BirdLife International 2004). The relatively high rate of discarding reported here is likely a result of PTT configuration (a repetition rate of 40 seconds is unusually frequent for tracking studies of albatrosses) and the relatively small spatial scale over which white-capped albatross foraged during the guard stage (see below). Filtering of PTT locations reduced the range (maximum distance reached from South West Cape) of foraging birds by approximately 7%, and the total distance travelled by approximately 29%.

Foraging trips of birds tracked using PTTs are summarised in Table 2. Two trips (marked *) occurred following the failure of that bird's nesting attempt, all other trips were by birds with active nests.

Table 2. Trip characteristics of white-capped albatross tracked using PTTs.

Band Number	Trip	Duration (hrs)	Furthest Distance (km)	Total Distance (km)	Mean Speed (km hr^{-1})
34117	1	71.42	513	1895	26.5
34117	2	56.83	458	1365	24.0
34118	1	29.75	103	386	13.0
34118	2	47.00	123	1130	24.1
34119	1	56.00	189	1132	20.2
34120	1	31.50	190	557	17.7
34120	2	45.42	328	1169	25.7
34121	1	23.58	151	445	18.9
34121	2	54.00	513	1681	31.1
34122	1	62.25	258	1315	21.1
34122	2	30.25	172	692	22.9
34122	3*	183.50	647	5659	30.8
34122	4*	254.17	2267	6694	26.3
34123	1	21.50	80	393	18.3
34123	2	52.17	292	1608	30.8
34124	1	48.92	350	1366	27.9
34125	1	23.58	105	423	17.9
34125	2	27.50	183	580	21.1
34125	3	36.75	129	704	19.1
34126	1	47.17	143	810	17.2
34126	2	52.25	444	1303	24.9
34127	1	48.67	271	932	19.1
34127	2	73.08	1138	3100	42.4
34128	1	20.17	90	373	18.5
34128	2	80.00	1019	3261	40.8
34128	3	32.83	120	437	13.3
Mean		44.69	307	1127	23.2
S.D.		17.11	274	780	7.4
Median		47.09	190	1031	21.1

* trips excluded from summary statistics.

Table 3 summarises all foraging trips tracked using GPS tags. Unlike two of the tracks recorded using PTTs, all GPS tracks were undertaken by birds with active nests. There were no significant differences in trip duration, furthest distance travelled from the colony, total distance travelled and mean speed between birds equipped with PTTs or GPS tags (Mann-Whitney U-tests for non-normal data, $P > 0.05$ in all cases). Combining PTT and GPS tracking data produced overall values for mean ± S.D. (and median) of

44.1 ± 17.1 hours (45.42 hours), 250 ± 214 km (183 km), 1051 ± 652 km (932 km) and 22.7 ± 7.0 km hr^{-1} (22.7 km hr^{-1}) for trip duration, furthest distance, total distance and mean speed, respectively.

Table 3. Trip characteristics of white-capped albatross tracked using GPS tags.

Band Number	Trip	Duration (hrs)	Furthest Distance (km)	Total Distance (km)	Mean Speed (km hr^{-1})
34129	1	38.50	330	988	25.7
34129	2	44.25	205	1023	23.1
34130	1	38.58	235	1028	26.7
34131	1	37.17	74	280	7.5
34132	1	34.00	106	543	16.0
34133	1	14.33	82	185	12.9
34133	2	83.17	526	2121	25.5
34135	1	20.00	110	347	17.3
34135	2	64.00	118	1053	16.4
34136	1	33.83	94	604	17.9
34136	2	20.50	106	534	26.1
34137	1	28.17	91	483	17.1
34137	2	71.00	318	2261	31.8
34138	1	49.00	380	1183	24.2
34110	1	48.00	118	1111	23.2
34140	1	48.33	131	923	19.1
34140	2	71.58	203	1547	21.6
34141	1	61.33	125	831	13.5
34142	1	51.17	279	1349	26.4
34143	1	50.08	234	1324	26.4
34144	1	43.42	114	775	17.9
34145	1	25.75	114	915	35.5
34146	1	22.50	340	785	34.9
34147	1	48.08	264	1345	28.0
34148	1	40.17	177	913	22.7
Mean		43.48	195	978	22.3
S.D.		17.39	115	506	6.8
Median		43.42	131	923	23.1

Figure 2 illustrates all locations and routes travelled by white-capped albatross tracked with PTTs, and Figure 3 illustrates in greater detail the PTT fixes and routes of two consecutive tracks undertaken by a single bird, the first almost due south from the colony, the second north and east to Foveaux Strait. Overall, most foraging trips were relatively close to the Auckland Islands, primarily to the east and south of the colony, although one bird travelled south and west of the archipelago to nearly 57°S and a second bird travelled north and west to approximately 43°S in the Tasman Sea. The relatively long track crossing the Tasman Sea and ending near Tasmania was the final trip tracked by the 'failed' bird, presumably making an early start to its migration away from New Zealand following breeding.

Figure 4 shows all GPS locations for all tracked birds. No routes have been specifically marked because the locations, at 3-minute intervals, effectively demark routes. Again, most tracks are relatively close to the South West Cape colony, mainly east and south of the colony. Figure 5 illustrates in greater detail GPS fixes from two consecutive foraging trips undertaken by the same bird, showing the importance of the area to the east of the archipelago, above a relatively gently-sloping feature extending onto the Campbell Plateau. Indeed, a kernel density plot of all the GPS data (Figure 6) highlights the importance to white-capped albatrosses during the guard stage of the zone immediately south and east of the Auckland Islands. The 50% density contour encompasses the coastal waters surrounding the southern half of the Auckland Islands, extending west approximately 50 km, south approximately 75 km and west approximately 160 km (Figure 6). Clearly, Fisheries Management Areas 6, in particular, and 5 are important for white-capped albatross during the guard stage, with some time spent beyond the boundaries of these Areas to the south-west and north-west (Figure 2). Given the relatively high resolution and accuracy of the GPS data, it should prove possible to quantify the proportion of time spent in close association with fishing vessels.

Compared to shy albatross *Thalassarche cauta* breeding in Tasmania, white-capped albatross appear to travel further, for longer and at higher speeds at a comparable stage of the breeding season. In 1995/96 and 1996/97 foraging trips of shy albatross during the guard stage lasted on average 1.1 days (1.8 days for white-capped albatross in 2006), mean furthest distance was 100 km (250 km here), total distance was 273 km (1,051 km here) and mean flight speed was approximately 10 km hr^{-1} (23 km hr^{-1} here) – all shy albatross data from Hedd *et al*. (2001).

4. Conclusions

In the light of the difficulties encountered during the first field trip reported here, a large-scale demographic study would appear problematic, not least because of the effects of feral pigs, but more importantly as a result of the birds' negative responses to capture, handling and, in some cases being approached by a field worker. At-sea distribution work proved more successful, but even here the same problems with bird capture and handling were encountered.

5. References

BirdLife International (2004). Tracking ocean wanderers: the global distribution of albatrosses and petrels. Results from the Global Procellariiform Tracking Workshop, 1-5 September 2003, Gordon's Bay, South Africa. BirdLife International, Cambridge, UK.

Gales, R. (1998). Albatross populations: status and threats. *In*: Robertson, G.; Gales, R. (eds.) Albatross biology and conservation, pp. 20-45. Surrey Beatty & Sons, Chipping Norton.

Hedd, A.; Glaes, R.; Brothers, N. (2001). Foraging strategies of shy albatross *Thalassarche cauta* breeding at Albatross Island, Tasmania, Australia. *Marine Ecology Progress Series 224*: 267-282.

Robertson, C.J.R. (1975). Report on the distribution, status and breeding biology of the royal albatross, wandering albatross and white-capped mollymawk on the Auckland Islands. In: Yaldwyn, J.C. (ed.) Preliminary results of the Auckland Islands expedition 1972-73, pp. 143-151. Department of Lands and Survey, Wellington.

Robertson, C.J.R.; Bell, E.; Scofield, P. (2004). Autopsy report for seabirds killed and returned from New Zealand fisheries, 1 October 2001 to 30 September 2002: birds returned by Ministry of Fisheries observers to the Department of Conservation. DoC Science internal series 155. Department of Conservation, Wellington. 43p.

Robertson, C.J.R.; Robertson, G.G.; Bell, D. (1997). White-capped albatross (*Thalassarche steadi*) breeding at Chatham Islands. *Notornis 44*: 156-158.

Taylor, G.A. (2000). Action plan for seabird conservation in New Zealand. Part A: threatened seabirds. Threatened species occasional publication No. 16, Department of Conservation, Wellington. 233p.

Tennyson, A.; Imber, M.; Taylor, R. (1998). Numbers of black-browed mollymawks (*Diomedea m. melanophrys*) and white-capped mollymawks (*D. cauta steadi*) at the Antipodes Islands in 1994-95 and their population trends in the New Zealand region. *Notornis 45*: 157-166.

6. Acknowledgements

We thank the Department of Conservation, Southland Conservancy for permission to visit South West Cape and for logistical support, and skippers and crew of *Tiama* and *Clan McCleod* for transportation to and from the Auckland Islands.