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A population and distributional study of white-capped albatross (Auckland Islands)
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Abstract

South West Cape, main Auckland Island, was visited during November-December 2007 (incubation stage) by a three-person field team to continue studies into the demography and at-sea distribution of white-capped albatross.

A further 12 geolocation tags were retrieved from birds tagged as breeders in previous seasons, bringing the total retrieved to date to 13. Of these, one tag was corrupted and produced no usable data. Of the remaining 12 tags, 11 sets of data revealed that birds remained within Australasia year-round, mainly within New Zealand's EEZ, and one tag revealed a migration to waters off South Africa and Namibia in each of two successive years. A total of 15 GPS tags were deployed on actively incubating birds. However, due to unpredicted and relatively long incubation shift lengths, most tags were subsequently removed before birds went to sea. One tag was successfully retrieved after a foraging trip and four further tags were retrieved after our departure from South West Cape. Of these five tags, one was corrupted and produced no usable data, but the remaining four tags produced high-resolution foraging trip information. These data revealed that birds foraged off the east coast of Australia, off eastern Tasmania and along the Chatham Rise, together with an area immediately to the south of the Auckland Islands.

Population studies continued with banding of additional breeding adults bringing the total of banded breeding birds within the study area to 93, and a total of 63 active and marked nests. Additionally, banding of potential recruits to the population within the study area continued, and breeding success was estimated from a follow-up visit to the colony in April 2008. A complete population estimate for the South West Cape area was attempted but some breeding areas could not be observed from land, and so this task was not completed. However, ground-truthing work was undertaken in support of another aerial survey of the entire Auckland Islands population. Observations of breeding frequency, nest-site occupancy and inter-annual variation in population estimates suggest that white-capped albatross is predominantly a biennially-breeding species.

Keywords

White-capped albatross, distribution, population, fishing activity, satellite telemetry, GPS, geolocation

Introduction

In New Zealand, white-capped albatross *Thalassarche steadi* breed primarily at the Auckland Islands archipelago (Auckland, Adams and Disappointment Islands: Figure 1), 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). An estimate of the white-capped albatross population in December 2006, based on aerial photography, found 110,649 (95%CI 110,040-111,258) breeding pairs at Disappointment Island and 6,548 (6,400-6,695) at South West Cape (Baker *et al*. 2007a). These totals represent considerable increases over previous estimates, although methodologies were not comparable. Despite being New Zealand's most numerous breeding albatross, 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 during the 2007-08 breeding season as part of the Conservation Services Programme project POP2005/02 - A population and distributional study on white-capped albatross (Auckland Islands). The objectives of the project are (1) to collect data describing the at-sea distribution of white-capped albatross, (2) to collect field data to allow estimation of white-capped albatross population size, and population parameters relevant to population viability, and (3) to analyse these data, including estimating population size, population parameters and distribution of white-capped albatross with reference to spatial and temporal fishing effort.

Fieldwork was carried out during mid November-early December 2007, corresponding with the incubation stage of the breeding season. The field team comprised David Thompson (NIWA, Wellington), Paul Sagar (NIWA, Christchurch) and Fiona Proffitt (NIWA, Wellington). A second, brief visit was made to the study colony at the end of March, 2008 in order to record nests with chicks, and so determine breeding success to that stage.

Methods

Study Site and timing of fieldwork

Following an initial period of fieldwork during the 2005-06 breeding season and a second period of fieldwork during March-April 2007, South West Cape, main Auckland Island, was again visited during November-December, 2007. This period corresponded with incubation, active nests being occupied by a single member of each breeding pair and a single egg. Based on previous work on the closely-related shy albatross *Thalassarche cauta*, which found that incubation stage foraging trip length averaged 2.8 days (Hedd *et al*. 2001), and in the absence of any prior knowledge regarding foraging trip lengths for white-capped albatross at this phase of the breeding season, we assumed that incubation phase foraging trips would be relatively short.

Fieldwork again focused on an area of feral pig-free sloping ground that could be accessed relatively safely with the aid of ropes and a hand-crafted rope ladder. We were confident that pigs could not gain access to this area, and there was no evidence to the contrary. It was noteworthy that by the end of our period of fieldwork, every white-capped albatross nest that we encountered, and which was clearly accessible to pigs (i.e. those nests at the base of bluffs on gently sloping ground, or otherwise those unprotected by steps, cliffs or very steeply sloping ground of at least 1 metre height), was either empty or either partly or totally destroyed. The feral pig population in the South West Cape region evidently has a considerable impact on many, if not all, accessible white-capped albatross nests.

A second visit to the study area took place at the end of March, 2008 to determine which nests were still active and contained a chick. This information was used to estimate breeding success (to March).

Data Collection

At-sea distribution

Two different electronic devices were deployed during 2007-08 in order to gather at-sea distributional data for white-capped albatross.

A total of 15 Earth & Ocean Technologies (Kiel, Germany) GPS data loggers were deployed on actively incubating adults. Given the nature of this species and its response to capture and handling (see Thompson & Sagar 2007a), device deployment was potentially problematic. Anecdotal evidence from other workers who had attempted to band incubating white-capped albatross noted that birds were very likely to desert the nesting attempt. Drawing upon experience gained in previous years, we were, however, able to deploy all devices successfully without any nest desertions, and all birds carrying a GPS logger continued to incubate. GPS loggers were attached using water-proof Tesa tape and fixed to contour feathers along the mid-line on the dorsal surface of the bird, slightly posterior of the wings (Phillips *et al*. 2003). Device attachment took less than five minutes per operation. Each GPS logger was programmed to record a fix every three minutes, a sampling frequency that would result in a ‘logger lifespan’ of approximately two weeks before the battery expired. Tag retrieval was necessary in order to download data as the GPS loggers were non-transmitting.

An additional 15 light-based geolocation tags (British Antarctic Survey, Cambridge, England; ‘Mk5 Micro Logger’, c. 4.5 g or c. 0.1% of body mass) were also deployed, on different breeding adults to those fitted with GPS loggers, to augment the 18 tags deployed in 2005-06 and the 13 tags deployed in 2006-07 (total number of geolocation tags deployed = 46). For these tags, twice-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 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. We aimed to retrieve as many of the geolocator tags deployed during the 2005-06 and 2006-07 breeding seasons as possible.

Population parameters

Fieldwork focussed on several key objectives:

A full, land-based population estimate of breeding pairs for the entire South West Cape area was attempted. Incubating birds were counted from vantage points from above using binoculars (Figure 2).

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. Additionally, non-breeding adults or failed breeders that were frequenting the pig-free slope were caught when possible and similarly banded with a uniquely numbered metal band. Band numbers of birds banded during 2005-06 and during 2006-07 were recorded.

All breeding attempts (presence of an egg in a marked nest) were recorded. Nests containing an egg in November-December were revisited in late March, 2008 to estimate breeding success, as the proportion of active nests during incubation that subsequently produced a chick.

Ground-truthing counts of breeding birds and 'loafers' (i.e. those birds within counting blocks that were not associated with active nests) were undertaken to assist with aerial photographic surveys of the Auckland Island white-capped albatross population (see Baker *et al*. 2007a). On 1 December 2007, three observers made counts at hourly intervals between 10:30 and 16:30 local time of birds within four, clearly defined counting blocks. Within each block and at each count, birds were recorded as either 'sitting' (a single bird sitting down on its nest), 'standing' (a single bird standing on its nest - we did not identify whether such birds had an egg or not as we could not see into the nest cup for all nests), 'pair' (an obvious pair at a nest, one bird sitting on the nest, the partner immediately next to the nest) or 'loafer' (a bird within the count area, not obviously associated with a nest and not on a nest). Additionally, we made counts of the proportion of nests which had a sitting (apparently incubating) adult bird with and without eggs. All of these data have been made available to the aerial survey team (Barry Baker and co-workers) and will not be discussed further here.

Results

Distributional data

All nests from which adults were captured and released carrying an electronic device remained active over the course of our visit. As far as we could determine there were no nest desertions as a result of our activity.

All 15 GPS data loggers were successfully deployed on incubating birds. However, it became obvious that our assumption that white-capped albatross would exhibit similar incubation phase foraging trip lengths as shy albatross, the closest related albatross taxon, was not valid. Whereas incubation phase foraging trips in shy albatross last, on average, 2.8 days (Hedd *et al*. 2001), we found that for nine birds carrying a GPS logger, the average time spent on the nest following deployment was approximately eight days (range 4-10 days). Furthermore, this value is obviously an underestimate of 'true' incubation shift length as each of these birds would have been incubating for an unrecorded number of days prior to GPS deployment. Similarly, for five birds that were relieved by their partners and left the colony, the minimum trip length averaged approximately 7.5 days – these birds were not seen at the colony again before our departure, so the 'true' trip length would have been longer. Maximum incubation phase trip length was 14 days, based on activity data retrieved from geolocation tags. Such relatively long incubation phase shift lengths were not anticipated for white-capped albatross based on currently available information. Using shy albatross as a model clearly resulted in underestimation of incubation phase foraging trip lengths in white-capped albatross and limited our ability to gather tracking data using GPS loggers. We were able to retrieve incubation phase foraging trip data from four GPS loggers.

Figure 3 shows the tracks from the four birds from which GPS locations were successfully downloaded. Only one data set produced a complete track, that from a bird away from the colony for only two days which travelled to the south-west of the colony. The remaining three tracks were incomplete with all birds still many hundreds of kilometres from South West Cape – two birds were to the east of Australia, the third just west of the Chatham Islands (Figure 3).

A total of 12 geolocation tags were successfully retrieved. These were a mix of tags deployed in 2005-06 and in 2006-07, and were, therefore, deployments spanning nearly two years and approximately eight months, respectively. One tag was corrupted and produced no usable data. The remaining 11 tags, together with the single tag retrieved from 2006-07 (see Thompson & Sagar 2007b) all produced twice-daily (midday and midnight) location information (Phillips *et al*. 2004).

All gelocation data, for all birds, are presented in Figure 4. We produced kernel density estimations, or utilisation distributions following BirdLife International (2004): the kernel search radius or smoothing factor was set at 300 km and the kernel grid size at 30 km. Kernels were generated using ArcGIS software. This plot demonstrates that at a population level and based on the data gathered to date, birds spend most time within the New Zealand's EEZ, but also utilise an area to the south east of Australia around Tasmania, and spend relatively little time off the coast of Namibia and South Africa within the Benguela system. Only one bird, from the 12 birds from which data were retrieved, migrated to southern Africa, in each of two successive years. This individual attempted to breed during 2006-07, but failed during incubation, based on activity and light curve data retrieved from its geolocation tag, and returned to southern Africa relatively early in breeding season, hence the relatively large amount of time spent off Africa compared to that spent within Australasia (Figure 5).When this individual bird is excluded from the utilisation distribution plot, it is clear that overall sub-Antarctic New Zealand together with waters off both the west and east coasts of South Island form the 'core' distribution of white-capped albatross (Figure 6). Figure 6 also highlights that, overall, waters off south east Australia form a relatively minor component of white-capped albatross distribution. However, on a seasonal basis, and in particular during the non-breeding phase of the annual cycle, white-capped albatross utilise an area to the north east of Tasmania (Figure 7). During the incubation phase, and especially during the guard stage, the distribution of white-capped albatross 'shrinks' to an area much more strongly centred on the colony, then expands to a relatively extensive area during chick rearing when the constraints of delivering small amounts of food to the newly-hatched chick are removed (Figure 7). These distributions based on geolocation data (Figure 7) accord with distributions derived from GPS and PTT sources at the same phases of the annual cycle, excepting that the limited number of GPS tracks derived during incubation and reported here (Figure 3) extend beyond the range of incubation phase distributions derived from geolocation tags (Figure 7).

Based on these initial 12 data sets, plus the single PTT-derived migration data set (Thompson & Sagar 2007b), only two of 13 birds (approximately 15%) appear to have migrated to southern Africa following breeding.

Population parameters

An attempt was made to census the white-capped albatross population throughout the entire South West Cape area from land-based vantage points (Figure 2). This proved impossible as several areas where breeding was almost certainly occurring could not be adequately observed. Given that a full and complete aerial survey was planned for 2007-08 (and subsequent years), following a successful aerial survey in 2006-07 (Baker *et al*. 2007a) our focus shifted from a full land-based count to ground-truthing work in support of the photographic survey (see Methods above).

Within the main, pig-free slope area, which forms the core study area at South West Cape, a total of 65 marked nests have been identified, along with a total of 93 breeding adult birds, including 35 banded pairs.

Of the pairs that were active at the chick-rearing phase during the previous breeding season (2006-07), approximately 75% did not attempt to breed during 2007-08, even though many of these birds were recorded at the colony. Overall, approximately 25% of nests within the study area were not used in 2007-08. No further analyses of the banding data have been made at this early stage of the demography study.

Breeding success was estimated at 62% for the pig-free slope, based on 28 live chicks at late March from 45 nests that contained an egg during the incubation phase.

Discussion and Conclusions

Tracking foraging birds during the incubation phase using GPS data loggers proved problematic in 2007-08. A relatively small amount of data was acquired, but our assumptions about likely foraging trip length were not sustained, with birds undertaking trips as long as 14 days. Although tracking work was only partly successful in 2007-08, we established that it is possible, with care, to deploy and retrieve tracking devices during the incubation phase – previous anecdotal reports suggested that at this stage of the breeding season, white-capped albatross are especially prone to nest desertion following capture and handling. Further tracking work (both GPS and PTT) is planned for the incubation stage of the 2008-09 breeding season, at both South West Cape and at Disappointment Island (permit dependent).

The retrieval of an additional 12 geolocation tags (11 producing location and activity data) enabled a preliminary assessment of year-round distribution to be made. It is very likely that these distributions (Figures 4-7) will change with the acquisition of further geolocation tags in the coming years. Perhaps the most striking feature of the data is that a minority of breeding adults migrate to southern Africa following breeding, currently estimated at approximately 15% of birds, with the remaining 85% remaining within Australasia, mainly New Zealand, year-round. It is noteworthy that the single bird that migrated to southern Africa did so in two consecutive years, and that the remaining seven birds for which geolocation data spanned two years remained within Australasia in each of these years. These preliminary data suggest that non-breeding period destinations are consistent year on year. The geolocation data also track distributions through the annual cycle (Figure 7), and demonstrate that foraging range is relatively restricted during the guard stage (when the newly-hatched chick is fed frequently by its parents), but more expansive during incubation and chick-rearing (post-guard). Obviously when free of the constraints of having to return periodically to the breeding site, the non-breeding phase distribution is the most extensive, with a 'hot-spot' off the north east coast of Tasmania. As southern Africa appears to be an area of particular risk to white-capped albatross, with perhaps in excess of 6,000 birds killed annually in this region (Baker *et al*. 2007b, Watkins *et al*. 2008), the apparent dichotomy in non-breeding period destination has clear implications for estimating the risk to this species from commercial fishing operations.

Several preliminary results suggest that white-capped albatross may breed predominantly biennially, and not annually as previously assumed. Firstly, comparing actively breeding birds with chicks in 2006-07, and the same birds/nests in 2007-08, we noted that approximately 75% of birds did not breed following a successful breeding attempt in 2006-07. This figure is conservative in that we were not able to definitively assign success to breeding attempts as we did not observe chicks fledge. Nevertheless, that 75% of apparently successful breeders did not breed in the following year is atypical for an annually-breeding species. Secondly, we noted that approximately 25% of usable nests on the South West Cape study slope were empty in 2007-08, although some of these were attended by birds that were actively breeding the previous year. Again, such a relatively high proportion of unused, but usable, nests is atypical of an annually-breeding albatross. Finally, Baker *et al*. (2008) noted a marked decline in numbers of breeding white-capped albatross at both Disappointment Island and South West Cape between 2006-07 and 2007-08: at Disappointment Island the count of breeding birds fell from 110,649 pairs in 2006-07 to 86,080 in 2007-08, and at South West Cape the count fell from 6,548 to 4,786 pairs (Baker *et al*. 2008). The most likely, but by no means the only, explanation for these results is that a proportion of breeding birds are not breeding in every year. In other words, such a dramatic shift in breeding population estimates is rarely, if ever, observed in annually-breeding species. When taken together, these preliminary lines of evidence support the idea that white-capped albatross is a predominantly biennial breeder.

5. References

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6. Acknowledgements

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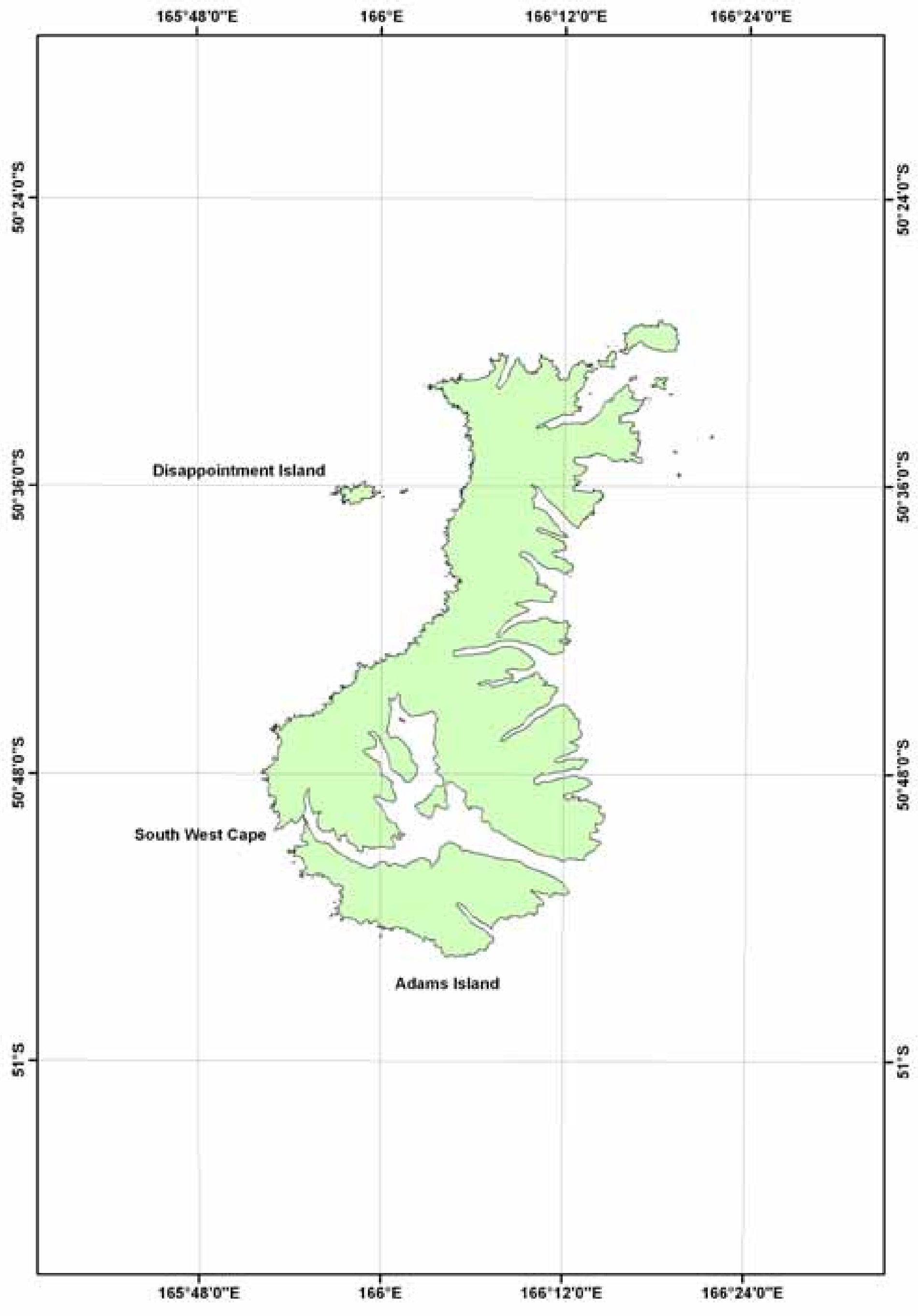

Figure 1. Map showing the locations of the three white-capped albatross breeding sites within the Auckland Islands archipelago.

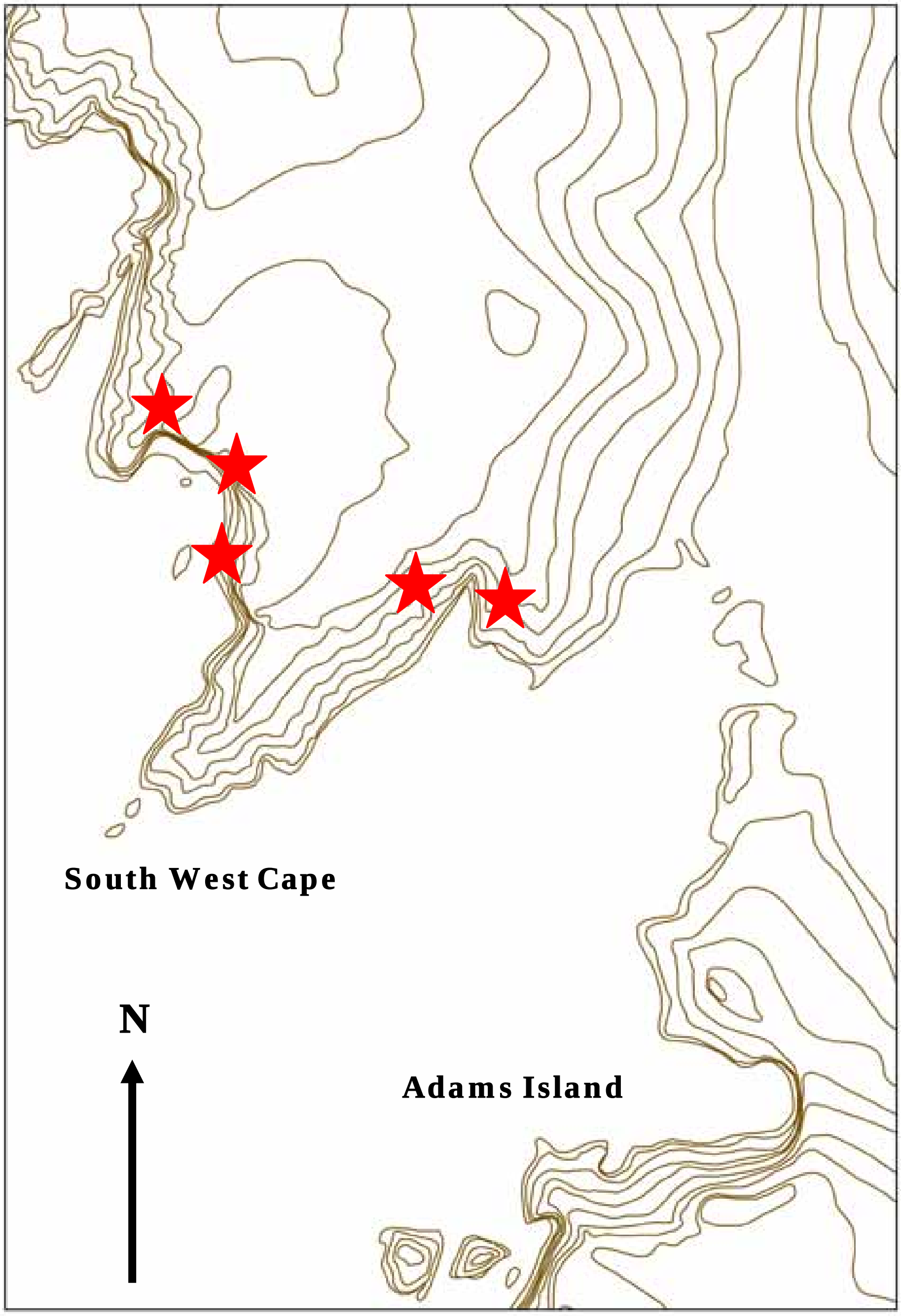

Figure 2. Map of the South West Cape area showing land-based vantage points (red stars) used for counting white-capped albatross nests. Contours are from 20 m at 40 m intervals.

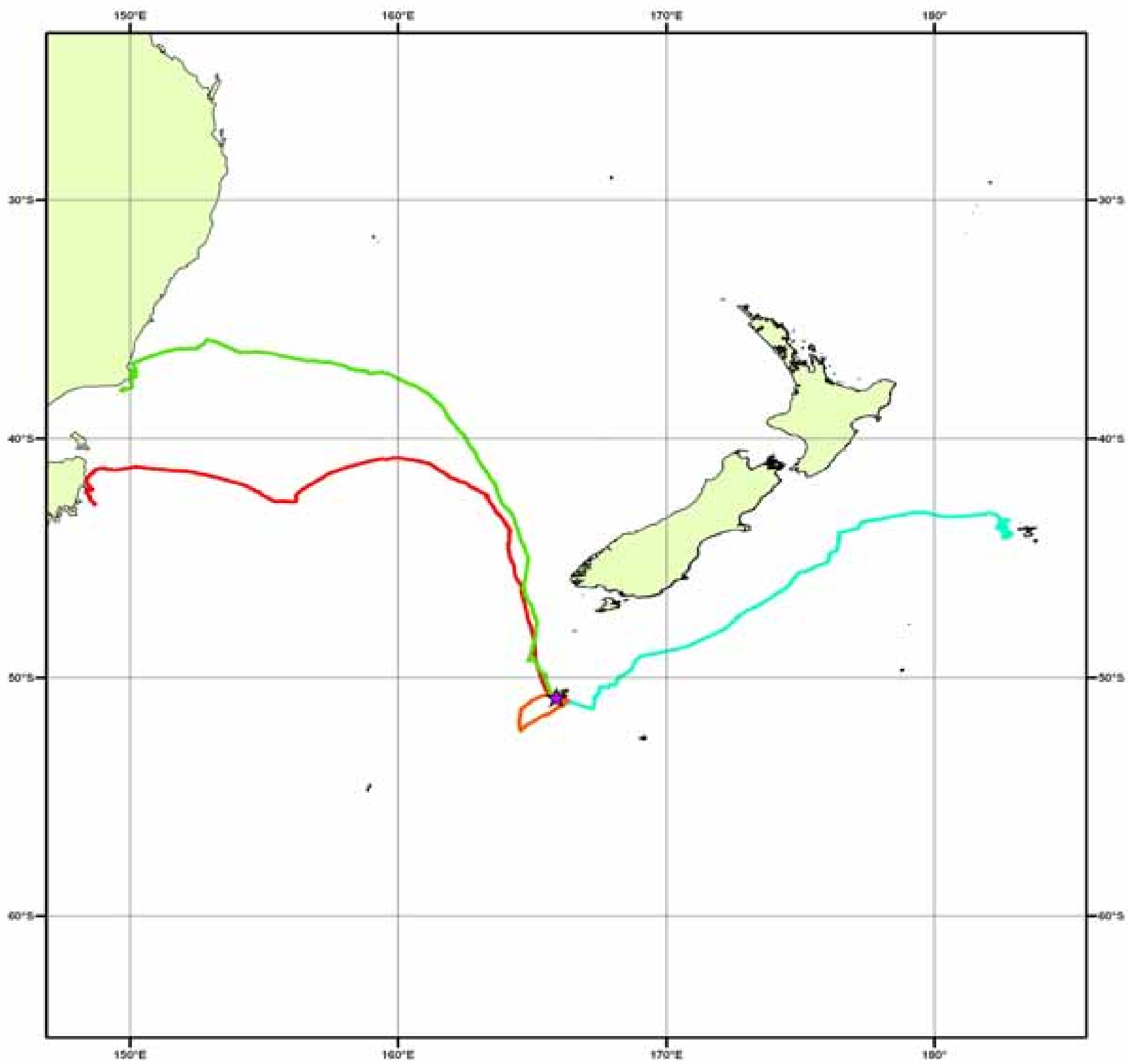

Figure 3. Map showing GPS–derived tracks for four birds during the incubation phase.
The purple star shows the location of South West Cape.

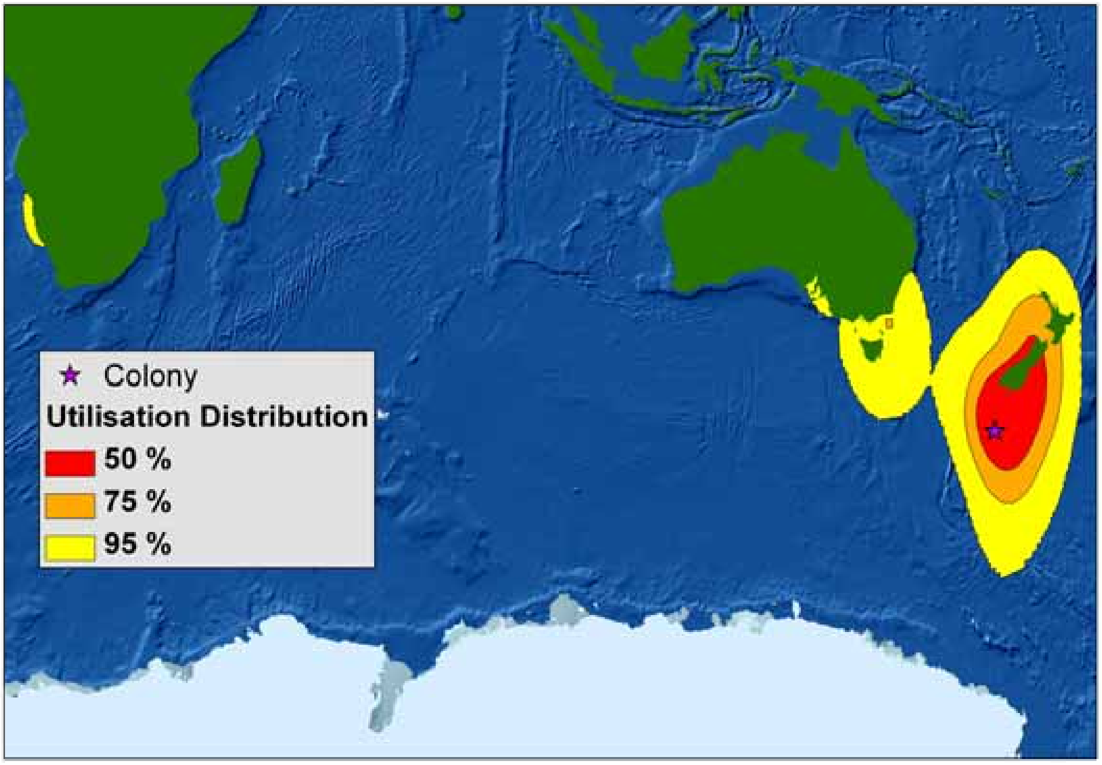

Figure 4. Plot showing Utilisation Distributions based on all geolocation data. Contours encompass that proportion of time spent by the study population when away from the colony at South West Cape, here marked with a purple star. The smoothing (h) parameter was 300 km and the grid size was 30 km in keeping with recommendations made by BirdLife International (2004).

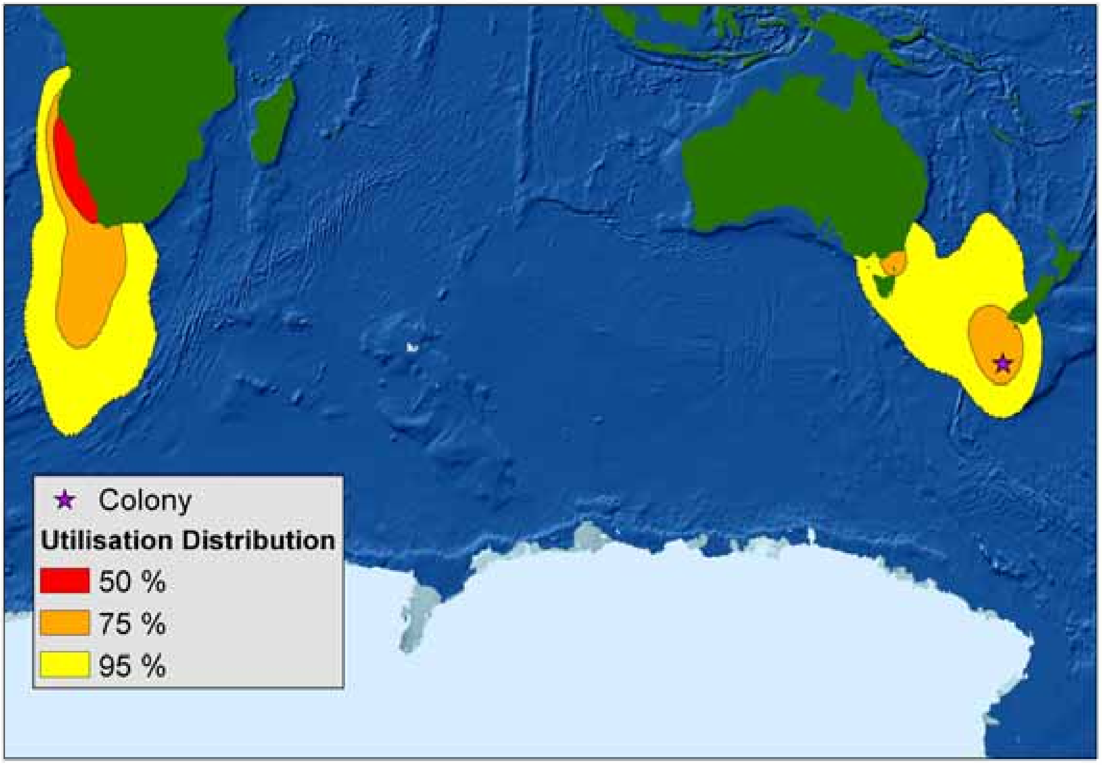

Figure 5. Plot showing Utilisation Distributions based on geolocation data from the bird making repeat migrations to southern Africa. Contours encompass that proportion of time spent by the bird when away from the colony at South West Cape, here marked with a purple star. The smoothing (h) parameter was 300 km and the grid size was 30 km in keeping with recommendations made by BirdLife International (2004).

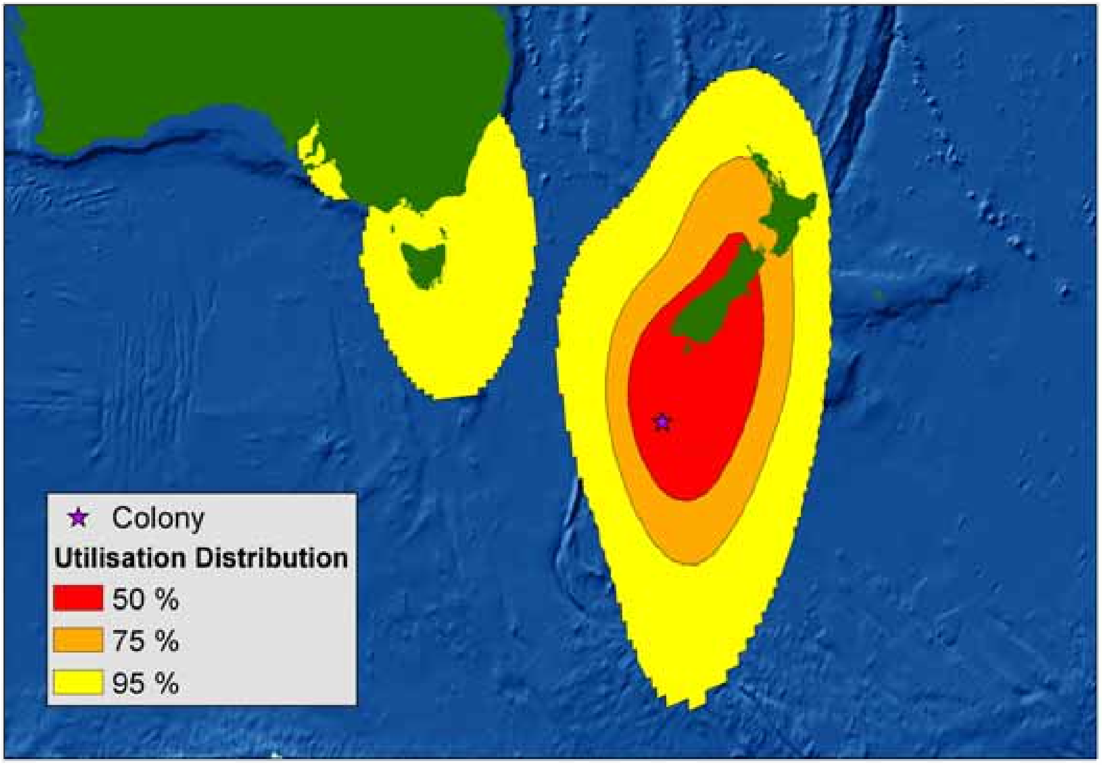

Figure 6. Plot showing Utilisation Distributions based on all geolocation data from all birds excepting the single individual making repeat migrations to southern Africa. Contours encompass that proportion of time spent by the bird when away from the colony at South West Cape, here marked with a purple star. The smoothing (h) parameter was 300 km and the grid size was 30 km in keeping with recommendations made by BirdLife International (2004).

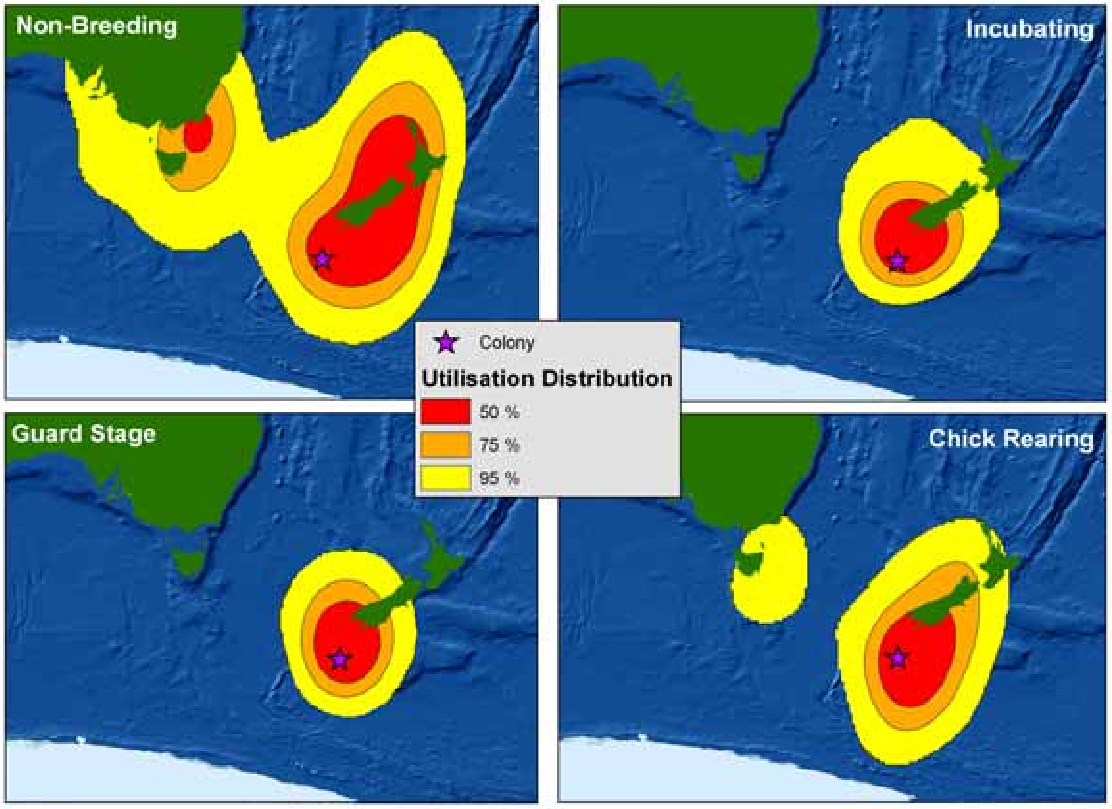

Figure 7. Plot showing Utilisation Distributions based on all geolocation data from all birds, excepting the single individual making repeat migrations to southern Africa, and by phase of the annual cycle. Contours encompass that proportion of time spent by the bird when away from the colony at South West Cape, here marked with a purple star. The smoothing (h) parameter was 300 km and the grid size was 30 km in keeping with recommendations made by BirdLife International (2004).