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EXECUTIVE SUMMARY

Sagar, P.; Thompson, D. (2008). Data collection of demographic, distributional, and trophic information on selected petrels. ***New Zealand Aquatic Environment and Biodiversity Report No.17.*** **12 p.**

This report is based on field work undertaken by a team based on Antipodes Island from 9 January to 27 February 2007 (50 days) to initiate a project to examine the demography and distribution of white-chinned petrels. The main aims of the field team were to begin a sampling programme that will allow estimation of population dynamics (specifically population size, adult survival, and breeding frequency of individuals) over the period 2007–2011. To allow estimation of population size and trend, the number and occupancy rate of white-chinned petrel burrows were determined in a total of 30 permanently marked 10 x 10 m quadrats that were established over a range of areas and habitats on the island during this visit. In addition, three larger, permanent quadrats, totalling 2.76 ha, were established and 260 white-chinned petrel burrow entrances marked to allow estimation of adult survival, breeding frequency, and population trend. Of these 260 entrances, 63 (24%) contained breeding attempts (an egg or chick). This occupancy rate is low relative to burrowing shearwaters, but similar to that recorded for Westland petrels in 2001. A total of 132 breeding birds from these burrows were banded. These birds responded well to handling, and so remote sensing devices will be deployed on them next season to track their foraging areas.

1. INTRODUCTION

Although most threats to seabirds are now well recognised, whether there are any direct link between these threats and observed population declines has been harder to establish. Effective management actions rely on an understanding of the population-level effect of specific threats, the sensitivity of the population to changes in vital rates of individuals, and the effects of threats on specific life history stages (Arnold *et al.* 2006). The detailed demographic analysis of the Black-browed Albatross population at South Georgia (Arnold *et al.* 2006) clearly showed that adult survival most affected lambda (λ, population rate of increase). Likewise, the findings of MFish Project ENV2005-08 indicate that sampling to estimate population size, adult breeder survival, and possibly breeding frequency are highest priority in understanding any influences of fisheries and other factors on seabird populations.

The selection of species and sites to undertake data gathering on population dynamics and foraging behaviour and ecology is based on (1) the high priority list given in the draft NPOA Seabird Research Plan (2005) and (2) the accessibility and representativeness of study populations. Under PRO2006-01, in 2007 NIWA was contracted to complete population and foraging studies of white-chinned petrels on the Antipodes (Objective 6). Additional population counts were to be made of northern giant petrels and light-mantled sooty albatrosses as opportunities arose.

The experienced team, comprising Darren Scott (leader), Erica Sommer and Dr Leigh Bull, was based on Antipodes Island from 9 January to 27 February 2007 (50 days).

2. OBJECTIVES

The overall objective of this project is "To gather demographic, distributional and dietary information on selected white-chinned petrels to allow assessment of effects of fishing on population viability."

The specific objectives of this project are as follows.

1. To design and complete an optimal sampling programme to allow estimation of population dynamics (specifically population size, adult survival and breeding frequency of individuals) of white-chinned petrels. (Specific Objectives 1–4 of tender brief)
2. To design and carry out an optimal sampling programme to determine the at-sea distribution and foraging behaviour of white-chinned petrels. (Specific Objectives 5–7 of tender brief).

3. METHODS

3.1 Objective 1

The methods used in this first season of field work were those recommended by the workshop on seabird demographic and foraging research under Project PRO2006-01, organised by MFish and held at NIWA, Christchurch, on 21 November 2006.

The workshop considered that for white-chinned petrels, estimating the whole population size is difficult, and requires a very large effort, and therefore was possibly outside the scope of the current study. This was because the terrain where this species nested was very densely vegetated and difficult to work in, especially around the coast. The workshop considered that robust estimates of trend, based on mark-recapture and count data (burrow density), would be preferable.

Permanent quadrats were considered necessary (e.g., 30–50 m^2), with researchers to follow changes in burrows through time. It would be desirable to put permanent stakes in place and map locations with GPS. The Workshop suggested 12–15 smaller plots would be workable. Occupancy would need to be

determined each year (e.g., burrow scope or playback which work well with this species). Confirmed breeding status for the whole would give most solid information.

The study could do counts of borrows (all species) with mapping of coordinates of each hole, and look at changes through time. Plots should include grey petrels and white chin areas (overlap and separately).

Following discussion, the Workshop concluded that population data (population size and trend, breeding frequency, and adult survival) should be recorded using the following methods.

Estimation of population size and trend

- Estimate occupancy rate by burrow scope/play back.
- Establish permanent marked quadrats (e.g. 30 @ 10 x 10 m) to estimate density.
- Repeat surveys of existing large quadrats.
- Concentrate on estimating trend only for white-chinned petrels, using a combination of mark-recapture and quadrat sampling.
- Consider doing a total population study in one year via stratified sampling.

Estimation of adult survival and breeding frequency

- Sample 2–3 areas intensively for mark-recapture work.
- Concentrate on the Northern Plain area for mark-recapture studies.
- Establish a buffer area around the intensive study areas to examine emigration.
- Aim for 50% recapture rate.
- 300 nests/burrows need to be studied.
- Follow the same set of burrows through time, not just the same initial birds.

Estimation of population size and trend

Quadrats. Bell (2001) reported little overlap between the nesting areas/habitat of grey and white-chinned Petrels. Based on this observation, a large proportion of the island was eliminated for use in this study as white-chinned petrel habitat. Thirty 10 x 10 m quadrats were established in a range of white-chinned petrel habitat in the Northern Plains (9 quadrats), Mt Galloway/Central Plateau (9), Clark Hill (3), Pipit Peak (3), Southern Plains (4), and Hut Bay (2) (Figure 1). All quadrats were located randomly after first determining that the habitat contained white-chinned petrel entrances. White or red plastic poles were used to mark the northern or most visible corner of the quadrat and were left in place for subsequent visits. When establishing each quadrat, three additional poles were used to mark the remaining corners and the area within the quadrat was systematically searched. The three poles were removed once the search was complete. Preferred habitat seemed to be either the short vegetation of the 'albatross country' (vegetation type A, Bell (2002)) or the damp upper slopes of Mt Galloway and scattered high points. This sampling ensured a range of vegetation types, elevations, slopes, and aspects were sampled. Though not sampled, it appeared that the highest density of qwhite-chinned petrel entrances was encountered on the slopes of Mt Galloway in the areas of *Stilbocarpa antipoda*, *Anisotome antipoda*, and *Pleurophullum criniferum*. The ground in these areas was very soft and prone to collapse, and so we did not survey within these fragile areas. Interestingly, it is the entrances in these areas that have previously been described for the species on this island. However, after comparing this nest type to others that are contained in our study areas, they appear to be of very poor quality, often with a large puddle of standing water ('moat') occurring at the entrance (Figure 2). One collapse in this fragile area revealed an incubating white-chinned petrel and egg in a very damp nest bowl with no nesting material.

Estimate of adult survival, breeding frequency, and population trend from mark-recapture analysis

Long-term study sites. Three sites were chosen as long-term study sites based on the presence of white-chinned petrel preferred habitat characteristics, entrances resembling those of white-chinned petrels found in the quadrats, and relative distance from the hut. The sites are located on the Northern Plains (A), Banana Ridge (B), and the Polar Front (C) (see Figure 1). A total area of 2.76 hectares was systematically searched for white-chinned petrel entrances with those of smaller burrowing petrel species recorded. Study Area A measures 50 × 100 m (0.5 ha), Study Area B 50 × 100m (0.5 ha) and Study Area C 160 × 110 m (1.76 ha). Red marker poles were left at the corner of each 50 x 50 m grid so that 6, 4[1], and 12 stakes were left at A, B, and C respectively.

3.2 Objective 2

The short time between signing of the contract and departure of the field team was insufficient to obtain remote sensing devices, and so no tracking of birds was undertaken.

[1] Only 4 stakes were left here (not 6) as we had run out of stakes due to the unexpectedly large nature of the study sites.

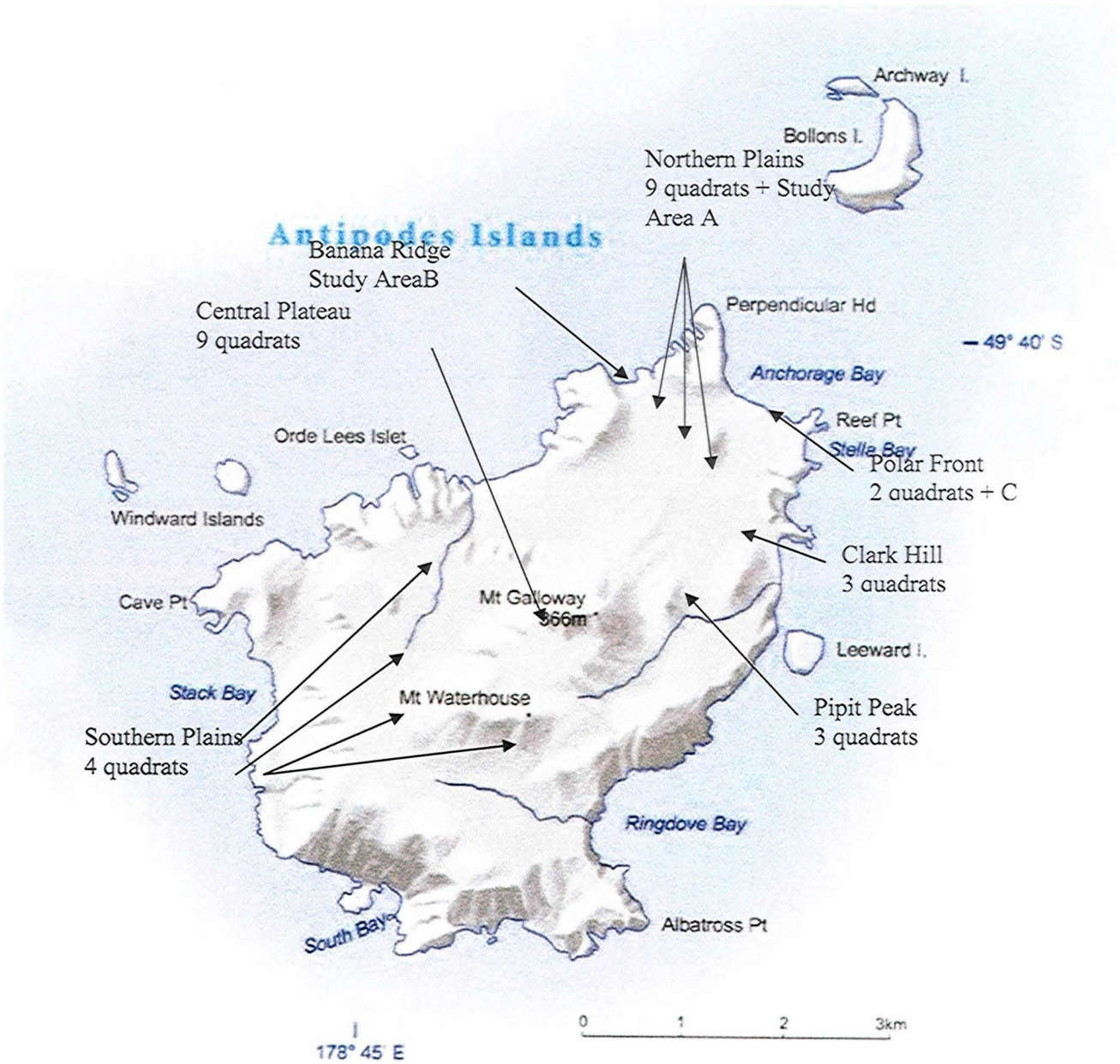

Figure 1: General locations of quadrats and study sites for white-chinned petrel study.

4. RESULTS

4.1 Estimation of population size and trend

Burrow entrances were typically large open depressions easily located, but in the thicker vegetation they were often hidden under large tussocks. Not all white-chinned petrel entrances were of the moat variety, with very few of these entrances encountered in our quadrats or study areas. A variety of methods was used to determine burrow occupancy: initially the burrow was searched using an arm, followed by a stick, and finally a hole (plug) was dug to gain access to the chamber if necessary (Figure 3). The length of burrows was found to be 50–380 cm (mean = 126 cm), with very few containing divisions to a second nest chamber. Attempts were made to place all plugs to the side of the nest chamber so as not to disturb the roof structure above the nest bowl. Plugs were created using a garden hand saw to remove earthen plugs; a spade was trialled but was quickly abandoned as a method for gaining access into the nest chambers. A total of 142 entrances were surveyed, of which 35 (25%) were solved using between one and four plugs and the remaining 107 (75%) using an arm or stick. White-chinned petrel chambers were usually large and often very wet, with the nest bowl being the driest part of the chamber. Nearly all burrows contained fleas and many contained ticks. Adult birds found in the quadrat entrances were not banded or measured.

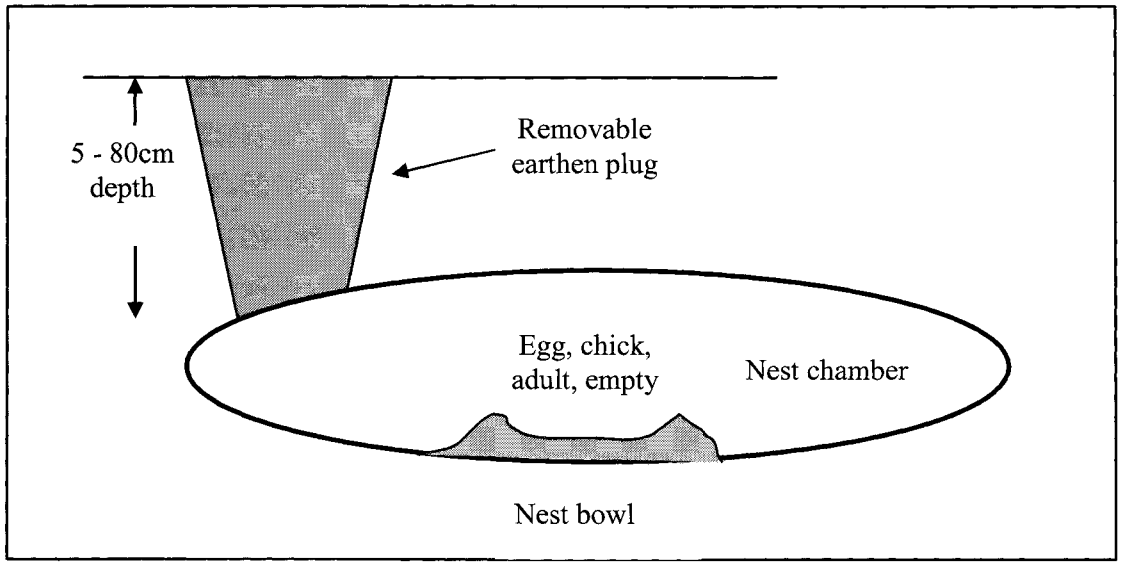

Figure 3: Plug method used for detection of occupant if out of reach with an arm or probing stick.

The number of entrances in the 30 10 x 10 m quadrats varied from 0 to 12. White-headed petrels (and burrow entrances) were encountered more often than white-chinned petrels in the quadrats. During this stage of the project, the team refined how to differentiate between white-chinned petrel and white-headed petrel entrances, and thus as the trip proceeded (i.e., the last four quadrats) the number of white-headed petrel entrances inspected was reduced. The number of occupied white-chinned petrel entrances ranged from one to two. Many of the unoccupied entrances had feathers and fresh digging at the entrance. There does appear to be some overlap in the size of burrows used by white-headed petrels and white-chinned petrels, but generally the larger entrances contained White-chinned petrels. White-chinned petrels are likely to be too large to fit down a white-headed petrel entrance. Entrances smaller than 8 x 8 cm (a closed fist) were counted, but the occupants not identified.

4.2. Long term study sites for mark-recapture analysis

A total of 260 entrances containing 269 burrows (24, 52, and 184 entrances in Study Areas A, B, and C respectively were marked with numbered cattle tags and surveyed, of which 245 (92%) were solved using between one and three plugs (Figure 3). A further 24 entrances (8%) were solved with an arm or stick[2]. All plugs were monitored during the trip for deterioration and any that were becoming worn were replaced using nearby tufts of bare soil/vegetation before departure from the island. Breeding attempts were detected in 63 entrances (24%), a further 16 entrances (6%) were occupied by non-breeding birds and the remaining 70% were vacant and deemed to be white-chinned petrel entrances due to the size of the entrance and evidence of fresh digging, feathers and or nest material inside the breeding chamber (Table 1).

Table 1: Percentage occupancy of entrances within the three study sites.

Study Site	Entrances	Breeding	Occupied Non-breeding	Vacant
North Plains (A)	24	4	2	18
Banana Ridge (B)	52	10	4	38
Polar Front (C)	184	49	10	125
Total	260	63	16	181

The relatively low occupancy rate of 23% found in this study may be typical of *Procellaria*. In a study of a total of 444 Westland Petrel (*Procellaria westlandica*) burrows in two colonies during 2001, Waugh et al. (2003) found that only 21 ± 2.8% were occupied. Such an occupancy rate was significantly lower that of Wedge-tailed Shearwaters (*Puffinus pacificus*) (46 ± 10.3%) and Sooty Shearwaters (44 ± 17.3%). Waugh et al. (2003) concluded that the lower occupancy rate for Westland Petrels could result from several factors, but not high nest losses at the sites during 2001, nor high levels of deferred breeding. Consequently, their findings suggested that the breeding population may have declined in recent years, or that a large group of non-breeding birds maintain burrows on the colonies. It should be possible to discern which of these is more likely for white-chinned petrels during future surveys of the study colonies on Antipodes Island.

Adults were generally easy to handle when they were incubating an egg, but became more difficult to extract from the breeding chamber when they were incubating small chicks, often bracing within the burrow with wings and feet outstretched. No adults were removed via the entrance. No abandonment was observed, although several birds did regurgitate when being removed or shortly after removal from the burrow/plug. A total of 132 white-chinned petrels were removed from burrows, banded (using stainless steel K-series bands), measured and returned to the breeding chamber. Three to four feathers were taken from each bird to allow determination of sex by genetic analysis. Breeding pairs were established from 47 of the 63 breeding attempts with a further 9 pairs completed from non-breeding burrows. Only one white-chinned petrel egg was measured (mass, length, and width). Chicks were weighed using a 300 g Pesola scale and measured (tarsus length, and bill length) using vernier callipers around the hatching period (23–27 January, $n = 9$). The first chick of the study was located in Study Area B on 23 January when establishing the study site and it was noted that chicks became very excited when disturbed within the breeding chamber and would disgorge oil very easily. While some chicks were unattended by adults from 27 January, there were also adults incubating eggs in February. Attempts were made to weigh and measure chicks at the end of the trip, but the amount of regurgitation of young chicks was unacceptable, so this was discontinued.

[2] The difference in entrances solved with the arm and stick between the quadrats and study sites is that within the study sites only definite white-chinned petrel entrances were identified for occupancy and white-headed petrel entrances were counted and not solved.

4.3 Grey petrel

Grey petrels where first seen on the island on 10 February. Small numbers were heard overhead the hut from 12 February and numbers continued to increase nightly until the team's departure from the island. Four of the 52 entrances (8%) in Study Site B were occupied by prospecting grey petrels on 17 February. One of these entrances was a white-chinned petrel burrow with a failed breeding attempt detected before the arrival of the grey petrels to the area. Two grey petrels were banded on a return trip to the site. Grey petrels were conspicuous within their burrows before they were prospected by their purring and chattering and fresh digging at the entrance. Grey petrels were not detected in either of the other two study sites.

The team did not repeat the survey grids of Bell (2002). These grids were not permanently marked in 2001, and so it was not possible to relocate the exact same boundaries from GPS coordinates alone. Two of the four study areas were visited to assess their possible inclusion in any forthcoming grey petrel study.

4.4 White-headed petrel

Up to six white-headed petrel breeding attempts were detected in each of the 10 x 10 m quadrats. Within the three study sites white-headed petrels where found to be breeding in three burrows with entrances classified as white-chinned petrel entrances in the Polar Front study area. No white-headed petrels were banded.

4.5 Northern giant petrel

Opportunistic counts of northern giant petrel nesting areas were completed during the course of the white-chinned petrel work. The number of chicks seen and GPS reference points were recorded at each site (Table 2).

Table 2: Numbers of Northern Giant Petrels recorded ashore at the Antipodes, 9 January-27 February 2007.

Location	Grid reference	Stage	Number (birds/chicks)
Polar Front 1	11762 9610	Incubating	1
Polar Front 2	11725 9608	Incubating	2
Mt Melville	9731 6479	Incubating	5
Ringdove Creek 1	9936 6002	Chick	2
Ringdove Creek 2	9949 5828	Chick	2
Central Plaeau	9302 7674	Chick	16
Crater Stella Bay	11850 9450	Chick	4
Crater Bay/Alert Bay Ridge	11765 9510	Chick	5

5. CONCLUSIONS

- In an initial attempt to estimate the total population of white-chinned petrels on Antipodes Island 30 randomly selected 10 x 10 m quadrats in a variety of habitats across the entire island were surveyed, for the occurrence of occupied white-chinned petrel burrows.

- To estimate population trend and examine adult survival over the 5 years of this project three large long-term study quadrats were established, and 260 white-chinned petrel burrows within these were marked.
- The breeding status of132 adult white-chinned petrels was recorded and the birds banded. In addition, we measured each bird and removed 3–4 feathers for determination of sex. The birds did not show undue stress when handled, and so should be suitable for the attachment of remote sensing devices during subsequent seasons.
- The numbers of breeding northern giant petrels in the areas surveyed for white-chinned petrels.

6. ACKNOWLEDGMENTS

This work was funded by Ministry of Fisheries Project PRO2006-01. The field study could not have been completed without the enthusiasm of the field team – Darren Scott (leader), Erica Sommer, and Dr Leigh Bull who worked in inclement weather and suffered the attentions of sharp beaks, fleas, ticks and lice; we appreciate their dedication. Thanks also to Henk Haazen, owner and skipper of the *Tiama*, for providing logistical support.

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