

Demographic parameters of the black petrel (*Procellaria parkinsoni*)

Elizabeth A. Bell, Joanna L. Sim and Paul Scofield

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Elizabeth A. Bell¹, Joanna L. Sim² and Paul Scofield³

¹ Wildlife Management International Limited, 35 Selmes Road, Rapaura, RD3, Blenheim 7273, New Zealand. Email: wmil@clear.net.nz

² Great Barrier Area Office, Department of Conservation, Private Bag, Port Fitzroy 0963, Great Barrier Island (Aotea Island), New Zealand

³ Canterbury Museum, Rolleston Avenue, Christchurch 8013, New Zealand

ABSTRACT

This report is part of an ongoing long-term study of the black petrel (*Procellaria parkinsoni*) on Great Barrier Island (Aotea Island), New Zealand, which was begun during the 1995/96 breeding season. During the 2004/05 breeding season (November to June), 362 study burrows were checked and intensively monitored. Of these, 226 were used by breeding pairs, 84 by non-breeding adults and the remaining 52 burrows were empty. By 29 April 2005, 175 chicks were still present in the study burrows and six others were presumed to have already fledged, corresponding to a breeding success of 80%. Nine census grids were monitored within the study area and accounted for 147 of the inspected burrows; 82 of these burrows were used for breeding. In addition to those burrows known from previous breeding seasons, a further 12 burrows were found in the grids. Twenty-four chicks from earlier breeding seasons were recaptured within the Mount Hobson colony area. Twenty-six random transects were also established within the 35-ha study site, and areas of high and low petrel burrow density and non-petrel habitat were identified. The study area was stratified according to these habitat types and the Mount Hobson black petrel population was estimated to be in the range of 3551–5021 birds.

Keywords: black petrels, *Procellaria parkinsoni*, monitoring, population estimates, breeding success, predation, bycatch, transects, Great Barrier Island (Aotea Island), New Zealand

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1. Introduction

The black petrel (*Procellaria parkinsoni*) is a medium-sized endemic seabird that is known to breed only on Hauturu/Little Barrier Island and Great Barrier Island (Aotea Island), New Zealand (Heather & Robertson 1996). The main breeding area on Great Barrier Island (Aotea Island) is around the summit of Mount Hobson (Hirakimata). The monitoring work outlined in this report, which was carried out during the 2004/05 breeding season (November to June), was a continuation of the survey and monitoring study that began in 1995/96 (Bell & Sim 1998a,b, 2000a,b,c, 2002, 2003a,b, 2005), and adds to the baseline data on the Great Barrier Island (Aotea Island) black petrel population. This study will assist in identifying the effects that long-line fishing, rat (*Rattus rattus* and *R. exulans*) and cat (*Felis catus*) predation, and habitat disturbance may have on the population. The population estimate has been updated, ensuring that any population changes will be detected in time to implement the appropriate management strategies.

2. Objectives

The main objective of this study was to undertake an annual census of the black petrel population on Great Barrier Island (Aotea Island) via burrow monitoring and the banding of adults and fledglings to determine adult mortality, breeding success and recruitment. Since this study was a continuation of work done during previous breeding seasons, it has also provided more data to investigate current population trends and to assist in determining the causes and timing of mortality.

In summary, the study objectives were to:

- Monitor a sample of black petrel burrows within the main breeding area and band all adults present in the burrows during November/December and January/February and all remaining fledglings during April/May.
- Collect data that can be used to calculate a population size estimate and determine population trends.
- Determine breeding success in the sample of long-term study burrows and record causes of breeding failure, such as predation or disappearance of parents.
- Monitor and re-survey the census grids and study area for new burrows, and band and recapture as many breeding and non-breeding birds present as possible.
- Calculate a population estimate by extrapolating from transect lines and grid areas to the main Mount Hobson breeding area.
- Continue the mark/recapture programme and band as many birds as possible at the beginning of the breeding season (November/December)

to determine juvenile (pre-breeder) survival, age of first return to the natal colony, age of first breeding attempt, age of first successful breeding attempt and adult (breeder) survival.

- Confirm the breeding status of adults during each visit to the colony (i.e. monitor the study burrows at the beginning, middle and end of the breeding season) and, where possible, identify the sex of the resident adult.

3. Methods

3.1 STUDY BURROWS

The study area (35 ha around the summit of Mount Hobson) was visited from 27 November to 10 December 2004. During this visit, the study burrows ($n=324$) were checked for the presence of adults and eggs. Any adult present was removed from the burrow, banded (or the band number recorded if it was a recaptured bird), sexed by viewing the cloaca (swollen in females; the cloaca is particularly obvious immediately after egg laying), and returned to the burrow. The presence of any egg was noted.

During the next visit to the colony (2-25 February 2005), the number of study burrows was increased from 324 to 362 (Figs 1-4). To ensure accurate monitoring, the study burrows were accessed either through the main entrance or through an opening that had been excavated in the burrow roof into the chamber; this opening was covered by a piece of plywood, which was camouflaged with soil and debris.

As for the first visit, any adult present in the burrow was removed, banded (or the band number recorded if it was a recaptured bird) and returned to the burrow. Eggs or chicks were noted if present; non-breeding birds were identified through the lack of eggs, eggshell fragments or chicks. The study burrows were monitored for a third time between 26 and 29 April 2005, and all remaining fledglings were banded. This information was used to determine breeding success.

The locations of study burrows were mapped by entering GPS coordinates into GIS mapping software (Arcview).

3.2 CENSUS GRIDS

The three original census grids were located in areas that had an historical presence of black petrels, different strata, vegetation types and topography, and that were near known launch sites (Bell & Sim 1998a, 2000a). These original grids were replicated to compare burrow densities between areas and to increase the accuracy of the population estimate (Bell & Sim 2000a,b).

The nine census grids (each 40 m × 40 m) set up around Mount Hobson were systematically searched (at 1-m intervals) to locate any new burrows

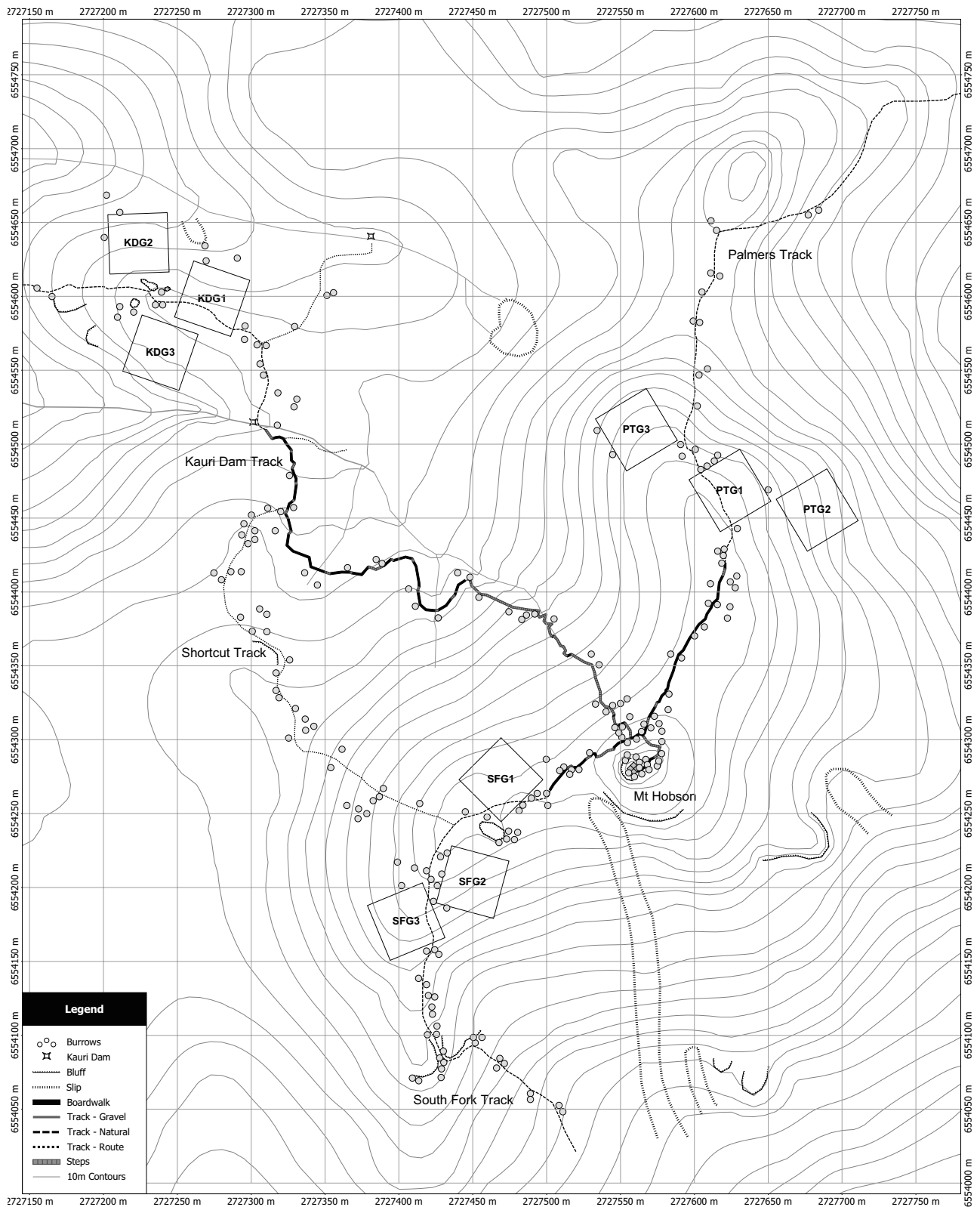
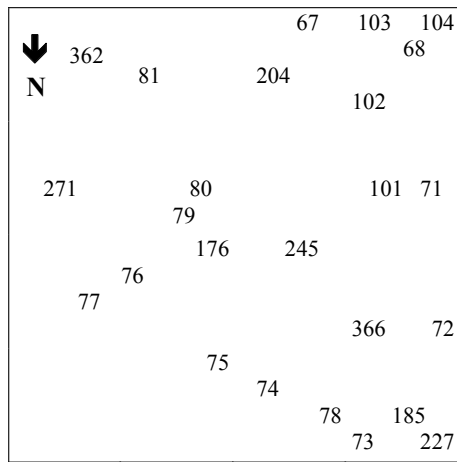
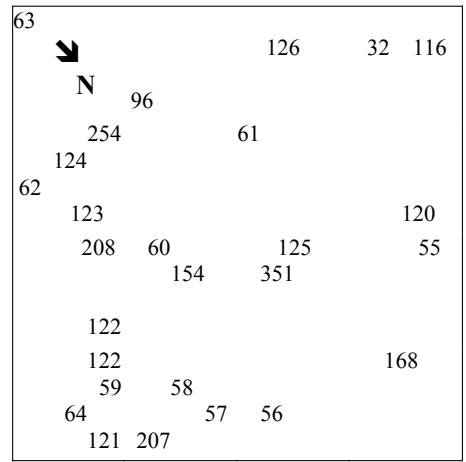


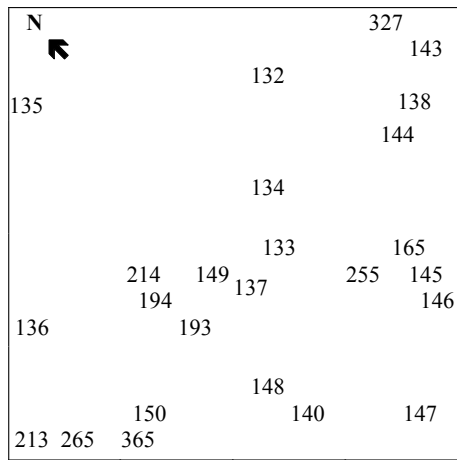
Figure 1. Location of black petrel (*Procellaria parkinsoni*) burrows and census grids around the summit area of Great Barrier Island (Aotea Island). Note that Figs 2, 3 and 4 show the burrow numbers within each of the nine census grids.



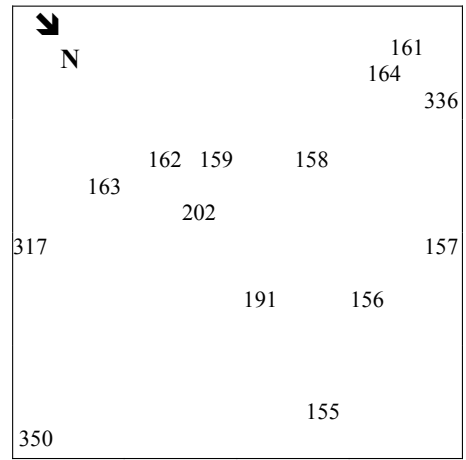
Kauri Dam Grid one (KDG1)



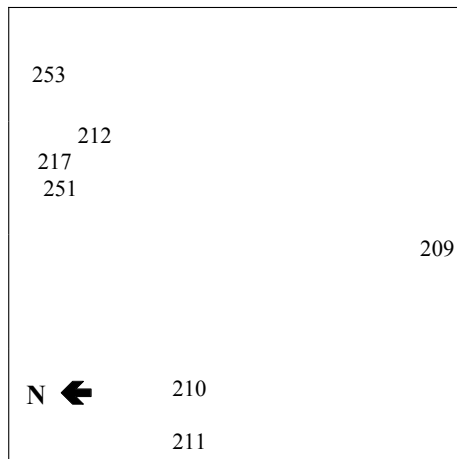
Palmers Track Grid one (PTG1)



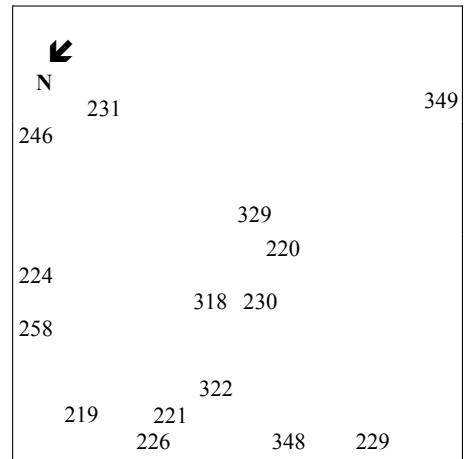
Kauri Dam Grid two (KDG2)



Palmers Track Grid two (PTG2)



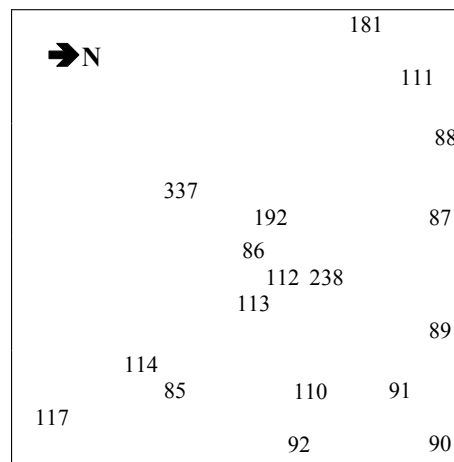
Kauri Dam Grid three (KDG3)



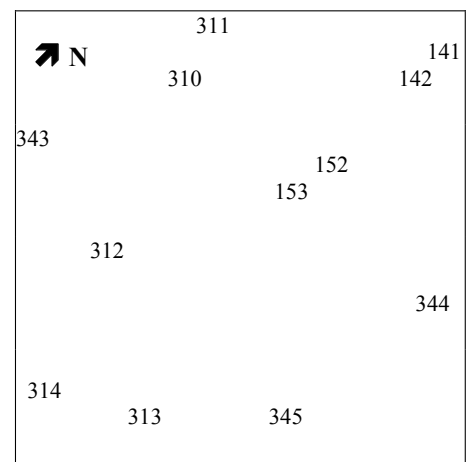
Palmers Track Grid three (PTG3)

Figure 2. Location of black petrel (*Procellaria parkinsoni*) burrows found in the Kauri Dam grid sites (each grid is 40 m x 40 m), Great Barrier Island (Aotea Island).

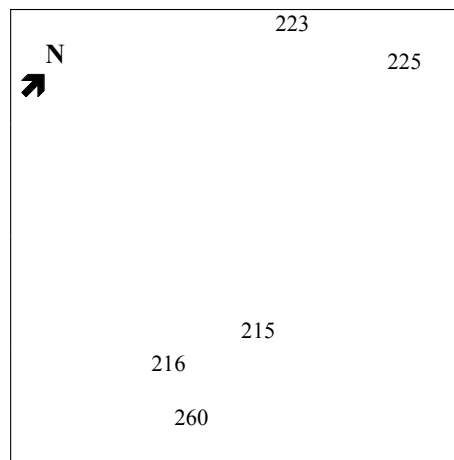
Figure 3. Location of black petrel (*Procellaria parkinsoni*) burrows found in the Palmers Track grid sites (each grid is 40 m x 40 m), Great Barrier Island (Aotea Island).



South Fork Grid one (SFG1)



South Fork Grid two (SFG2)



South Fork Grid three (SFG3)

Figure 4. Location of black petrel (*Procellaria parkinsoni*) burrows found in the South Fork grid sites (each grid is 40 m × 40 m), Great Barrier Island (Aotea Island).

and to determine occupancy (Figs 1-4). The same procedure was followed for all birds in the burrows in the grids, as outlined in Section 3.1. This information was also used to determine population estimates. Confirmed breeding burrows (i.e. those with eggs or chicks present or with proof of an egg having been laid that may have already failed) were assumed to have a 1:1 sex ratio (i.e. one male and one female bird using the burrow only) and non-breeding burrows were assumed to only have one bird using the burrow (i.e. male trying to attract a female).

The locations of the nine study grids were mapped by entering GPS coordinates into GIS mapping software (Arcview).

3.3 TRANSECTS

To obtain a better population estimate for the 35-ha study site, random transects were sampled throughout the study area (Fig. 5). Random GPS start points and compass bearings were selected for each transect. All transects were 400m in length, unless they reached the boundary of the study site or a cliff. A 2-m strip was searched for burrows on either side of each transect. To maintain a consistent search effort, each transect was searched in

10-m lengths. To minimise the edge effect, burrows on the east or north side of the transect were counted if any part of the burrow entrance was within the 2-m strip, and burrows on the west or south side of the central line were counted only if the entire burrow entrance was within the 2-m strip.

Any burrow located within the search area was recorded (and its position was marked by GPS) and searched for the presence of birds and eggs or chicks. The same procedure was followed for all birds in the transect burrows, as outlined in Section 3.1. Petrel sign (i.e. droppings) or burrows outside the 4-m width of the transects were noted.

Details of vegetation (species and density), slope, aspect and general information on burrows were recorded. The start and finish points of each transect were entered into GIS mapping software (Arcview) using GPS coordinates. The boundaries of the study site were also mapped into Arcview and the area of the study site was determined. The coverage area (two-dimensional only) of different petrel habitat types within the study site was also determined using Arcview (Fig. 6).

Once the coverage areas of the different habitat types were determined using Arcview, the population estimate was calculated using the following stratification of the study area. The transects were separated into habitat type (i.e. high (> 50 burrows/ha) or low (< 50 burrows/ha) petrel burrow density) and the burrow density (and number of black petrels present) per habitat type in each transect was extrapolated to the entire area. Once the high and low burrow densities for each transect had been extrapolated to the two habitat types, these were averaged and then added together to obtain the black petrel population estimate for the entire study area.

3.4 NIGHT BANDING

Night work was undertaken during the December visit to the study area. This involved searching the study area by walking the track system and capturing any adult on the surface. Several nights were also spent at known launch sites, where birds were captured while taking off or landing. All birds were banded or had their band numbers recorded. During this visit, sex was determined (by cloacal inspection) when possible.

3.5 SURVIVAL ESTIMATES

Adult survival, juvenile survival estimates and population trends were determined using Program MARK (www.cnr.colostate.edu/~gwhite/mark/m; viewed 9 June 2005).

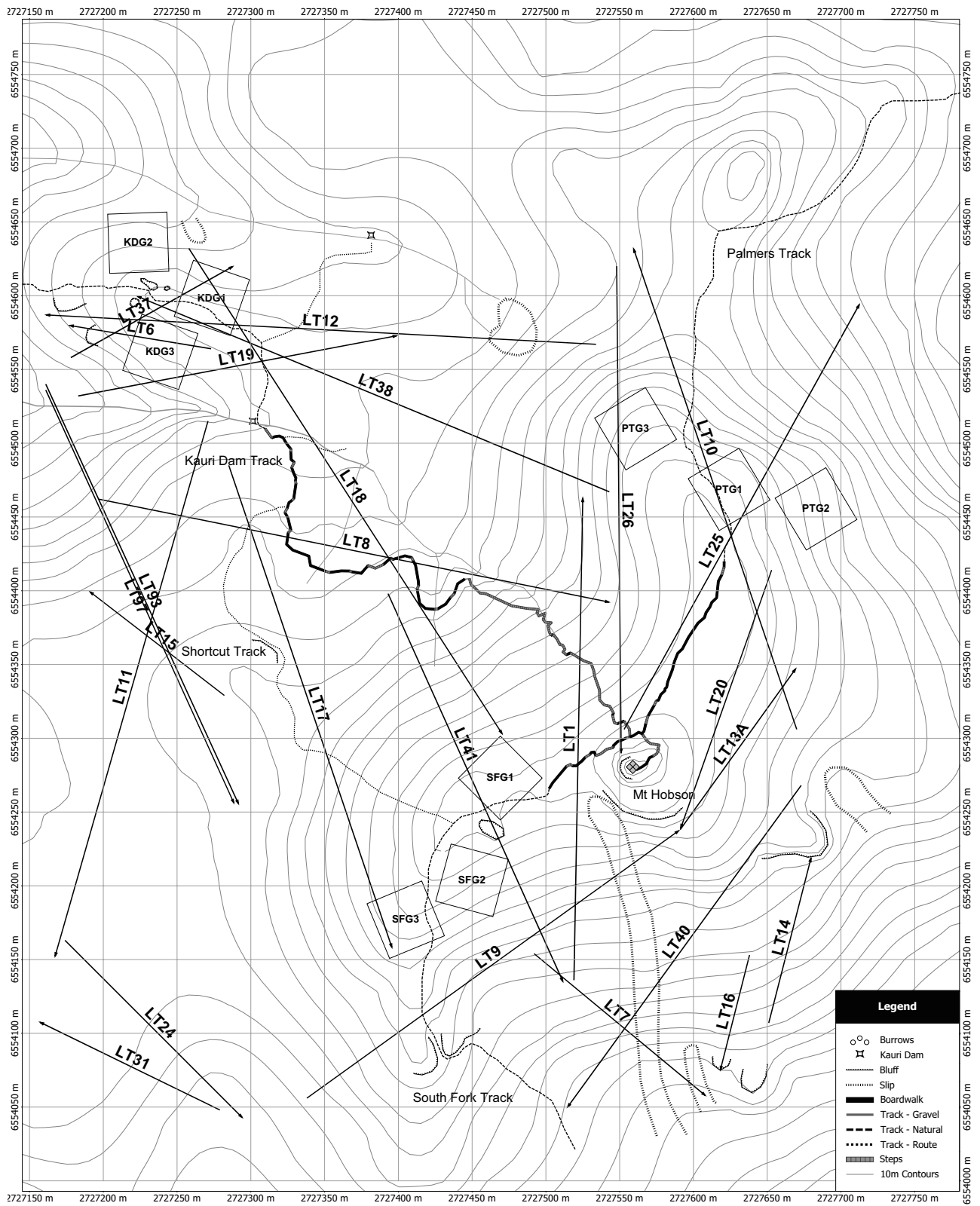


Figure 5. Locations of transects within the study site on Great Barrier Island (Aotea Island).

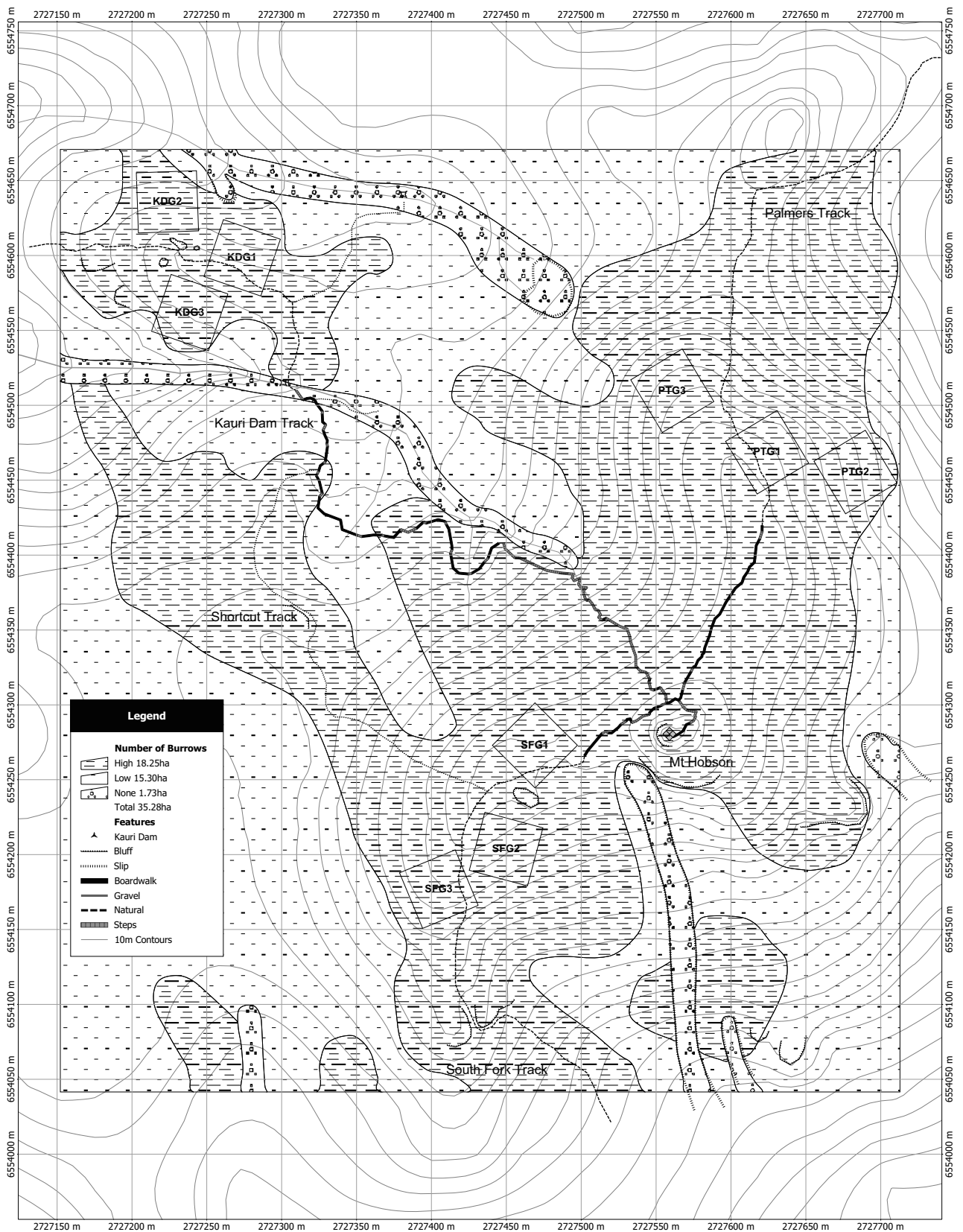


Figure 6. Optimum, poor or non-petrel habitat types in the study area on Great Barrier Island (Aotea Island). Total optimum petrel habitat (> 50 burrows/ha) is 18.25 ha, total poor petrel habitat (< 50 burrows/ha) is 15.3 ha and total non-petrel habitat is 1.73 ha.