

Survey and monitoring of black petrels on Great Barrier Island 1996

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Abstract

The black petrel (*Procellaria parkinsoni*) is a vulnerable endemic seabird, which breeds only on Little and Great Barrier Islands, New Zealand. Three census areas (1600 m² each) were set up in 1996 within the main breeding area, around the highest point on Great Barrier Island, Hirakimata (Mount Hobson). In February and April, 60 burrows were located within these areas, of which 20 were being used by breeding pairs. Another 26 study burrows, with adults, eggs or chicks present, were selected in February, and 22 of them were used by breeding pairs. A preliminary estimate extrapolating from the study burrows is that the Hirakimata population consists of 1250 breeding pairs and at least 750 non-breeding birds.

Predation was noted in one study burrow and one egg was also abandoned. Overall breeding success was 100% in the census grids and 90.9% when the 26 other study burrows were included.

Thirty seven adults were banded either from the study burrows or at launch sites in the summit area. Another 16 adults which were caught were already banded. Fifty nine chicks were banded (with 31 from the study burrows). Every captured bird was weighed: the average adult weight at incubation was 728 g and the average chick pre-fledging weight was 1069 g.

Although there was no direct evidence of long-line fishing affecting the black petrel breeding population during this study, recent by-catch has been noted. It is important to continue studying the Great Barrier Island black petrels to determine the dynamics of the population, in particular survivorship, mortality, productivity and breeding success. In the future, this information can be used to determine any effects the long-line fishing industry might have on the population.

1. Introduction

The black petrel (*Procellaria parkinsoni*) is a vulnerable New Zealand endemic seabird (Collar et al. 1994), and is the smallest of its genus (Imber 1987). Once found on ranges throughout the North Island and northwestern South Island, black petrels now occur only on Little and Great Barrier Islands (Bell & Brathwaite 1964, Imber 1976, 1987, Scofield 1989, Ornithological Society of New Zealand 1990).

Great Barrier Island is the main black petrel breeding location (Figure 1, Imber 1987). On this island, black petrels are found only in forested areas over 300 m above sea level, with the main breeding area around the highest point, Hirakimata (Mount Hobson). Other areas (such as Hog's Back, Cooper's Castle, and Te Ahumata) have been surveyed and some breeding has been noted (Imber 1987, Scofield 1989). Black petrels breed in summer and then migrate to the

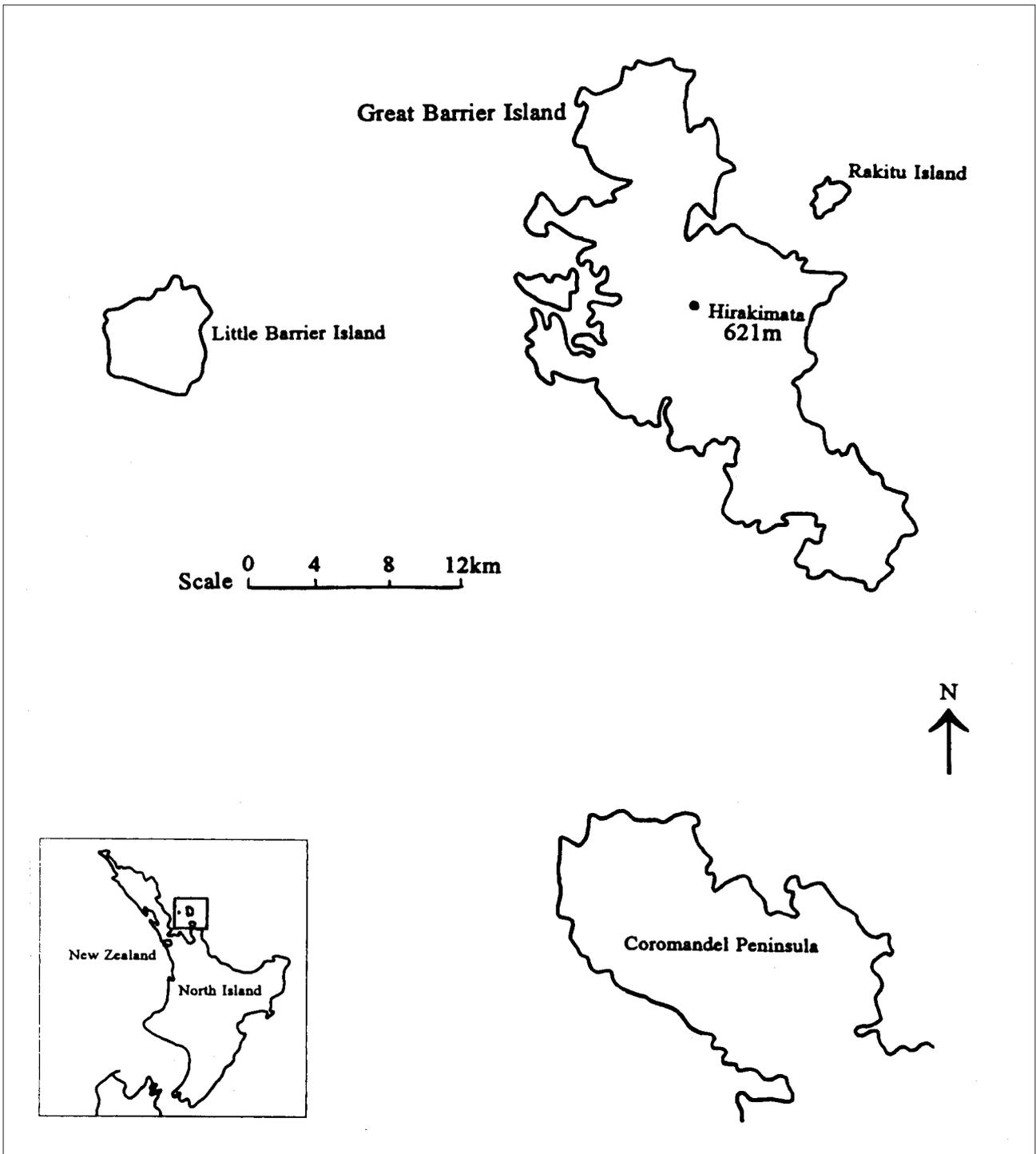


FIGURE 1. LOCATION OF GREAT BARRIER ISLAND.

eastern tropical Pacific (Imber 1976). They have a long chick-rearing period (approx. 105 days), with egg laying in November/December and chick fledging mainly in May/June (Imber 1987), compared with the other summer-breeding *Procellaria* species, the white-chinned petrel, *P. aequinoctialis*.

Black petrel breeding success on Great Barrier Island is lightly affected by rat and cat predation (Imber 1987, Scofield 1989) with possible impact by the domestic and foreign long-line fishing industry.

Black petrels feed mainly on squid (Imber 1976), and forage principally within sub-tropical areas, mainly east of the northern North Island (Imber 1987). In this area, there is long-line fishing for many months of the year, which makes black petrel vulnerable to by-catch on the lines. In New Zealand waters, black petrels have been hooked in both commercial and recreational fisheries (Sandy Bartle, pers. comm.). Black petrels feed in 'high risk' areas (such as northern New Zealand) and then migrate to South America, where by-catch of unknown cause and numbers has occurred (Sandy Bartle, pers. comm., Imber 1987).

2. Objectives

This study aims to provide data to establish current population trends of the Great Barrier Island black petrel, and to determine causes and timing of mortality.

In summary, the objectives are:

1. To establish 3 census areas in different parts of the main black petrel breeding area on Great Barrier Island. Band and recapture as many breeding and non-breeding birds present as possible.
2. To determine breeding success in each area. Causes of breeding failure, such as predation or disappearance of parents, are to be noted.
3. To conduct preliminary surveys of known black petrel breeding areas to obtain a more accurate census of the population, and to search other areas thought to be suitable for black petrel breeding.

3. Methods

Three census areas were set up in areas at different altitude and with different vegetation types around Hirakimata. This was done at the end of the egg laying period (29 January-16 February) to determine the number of breeding pairs, and again just before the chicks departed (1-20 April) to determine breeding success. As many birds as possible were banded and weighed. Evidence of predation (by rats and feral cats) was noted.

The three census areas were located on the Palmers, Kauri Dam and South Fork Tracks (Figure 2). These areas were near known launch rocks (i.e. take-off sites), and selected for ease of access along the main track system. Once the sites were chosen, a compass bearing perpendicular to the track was taken. Each study grid was originally 20 × 20 m (400 m²), but because low numbers of burrows and birds were found in February, the grids were increased to 40 × 40 m (1600 m²) during the April visit.

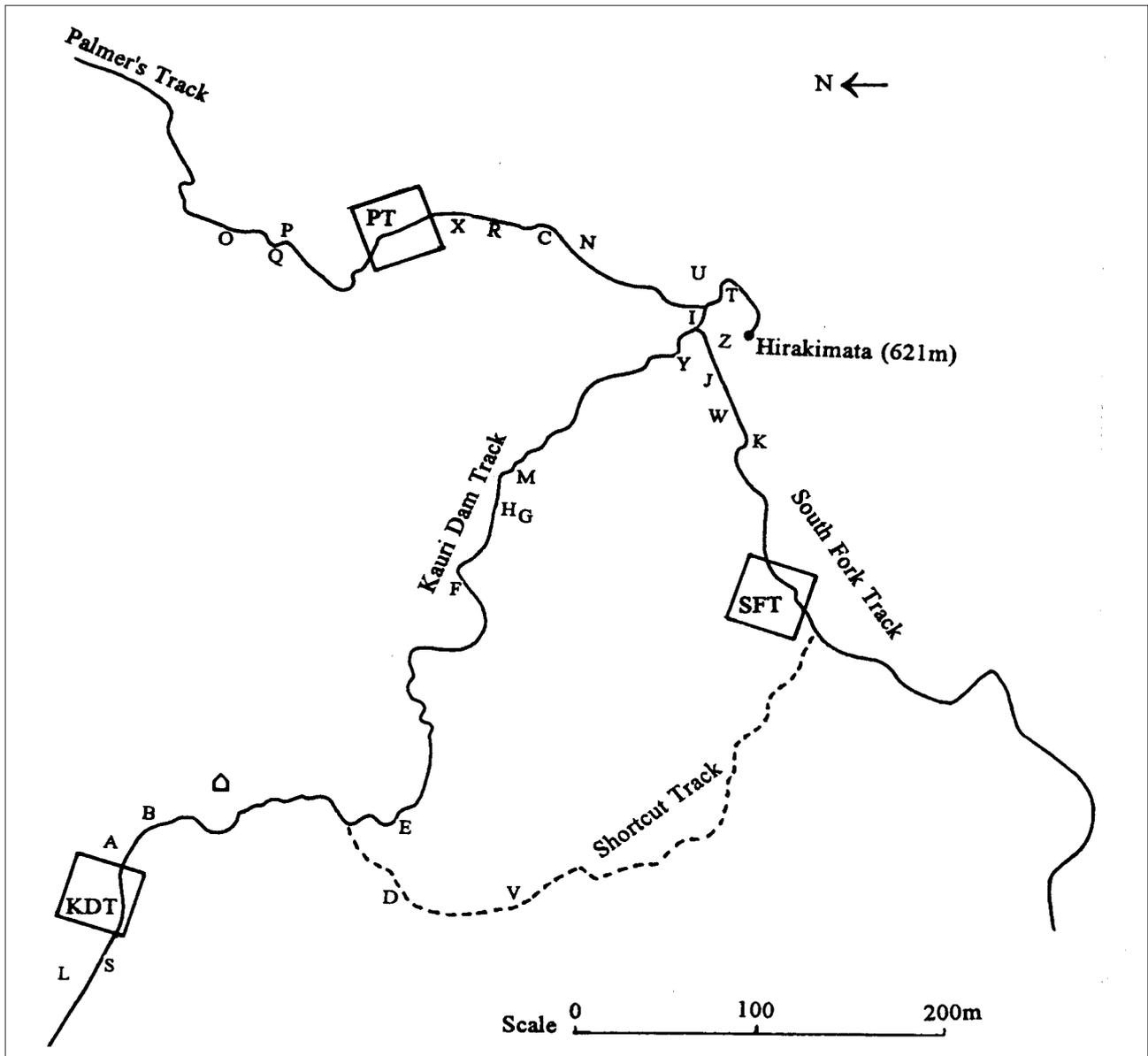


FIGURE 2. LOCATION OF BLACK PETREL CENSUS AREAS AND 'ALPHABET' STUDY BURROWS, GREAT BARRIER ISLAND.

String was used to mark the sides of the grids, with each corner labelled by tape. All burrows that were found within the grids were marked using tape or plastic tags, and their contents were determined by the use of sticks, torches, and a 'burrowscope' (camera mounted at the end of a long flexible pipe). During February, wherever possible, adults were removed from the burrow, banded, and weighed. Any eggs or chicks present in the burrows were noted, and the lack of eggs or chicks identified non-breeder birds. During April, chicks were banded and weighed where possible.

Owing to the small number of burrows located within the 20 × 20 m grids in February, a further 26 burrows were selected along the track system connecting the grid sites (Figure 2). They were selected only if there was an adult or chick present. The burrows, which were found within approximately 1 m of the track, were labelled alphabetically. They were still monitored in April to gain a better idea of breeding success.

TABLE 2. BREEDING SUCCESS AND CAUSES OF MORTALITY OF BLACK PETREL, 1996.

	Kauri Dam	Palmer	South Fork	Subtotal	'Alphabet'	Total
Number of burrows	23	19	18	60	26	86
Eggs - laid	8	7	5	20	22	42
Eggs - rat predated	0	0	0	0	1	1
Eggs - abandoned	0	0	0	0	1	1
Chicks - hatched	8	7	5	20	20	40
Chicks - fledged ¹	8	7	5	20	20	40
Overall breeding success	100 ³	100 ³	100 ³	100 ³	90.9 ²	95

¹All chicks were still present at the end of the April visit. It was assumed all would fledge safely.

²This figure is biased, since these burrows were chosen with adults, eggs or chicks present.

³These figures are not considered accurate, as the sample size is not statistically significant.

and Hirakimata summit platform). Four were recaptured at the same site on later dates, with two birds captured more than once (i.e. 36 captures over seven nights). Eight of the 30 birds had already been banded, and therefore were only weighed, while 22 other birds were banded and weighed (Table 4). Two of the adults caught at Kauri Dam launch rock were from study burrows (KT5 and Burrow 'B'). The adults from the study burrows were also weighed (Table 4).

In April, chicks (and the one female) present in the study burrows were also weighed. During this visit, a preliminary survey was also completed around the Hirakimata area and any chicks located outside the study areas were banded and weighed (Table 4).

In February, the breeder burrows contained adults and eggs or chicks, while in April, chicks were found alone (with one exception where a female was with the chick). Whenever possible the adults and chicks were banded. Altogether 23 adults and 31 chicks were banded in the grids and 'alphabet' burrows (Table 3).

During February, 30 adults were caught as they left from two launch sites (Kauri Dam launch rock

TABLE 3. NUMBER OF BURROWS WITH BANDED BLACK PETREL CHICKS AND ADULTS (PARENTS).

	Kauri Dam	Palmer	South Fork	'Alphabet'	Total
Neither chick or adults banded	2	2	1	2	7
Only chick banded	5	3	3	7	18
Chick and one adult banded	0	2	1	7	10
Chick and both adults banded	1	0	0	2	3
One parent banded	0	0	0	1	1
Both parents banded	0	0	0	3	3
Total	8	7	5	22	42

TABLE 4. AVERAGE WEIGHT OF BLACK PETRELS IN ALL THE AREAS.

	Kauri Dam	Palmer	South Fork	'Alphabet'	Non-study	All areas combined
Adult	870	825	760	746	701	728
Chick	1003	1120	1190	1080	1049	1069

The average adult weight was 728 g (range: 590-1000 g) and the average weight of random-aged chicks was 1069 g (146% adult weight, range: 620-1430 g). Figure 4 shows the spread of adult and chick weights.

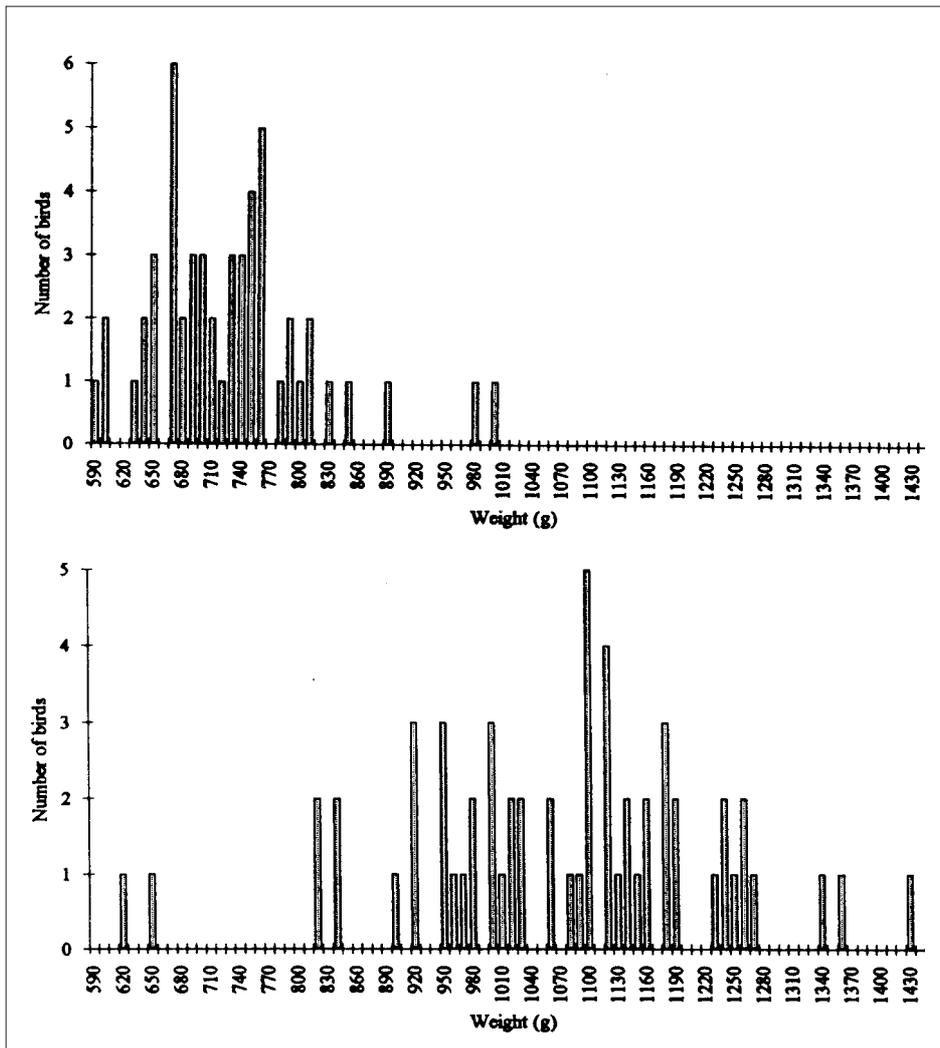


FIGURE 4. FREQUENCY DISTRIBUTIONS OF BLACK PETREL WEIGHTS. UPPER, ADULTS; LOWER, CHICKS.

Extrapolating from the three census grids to the 30 ha area around Hirakimata, the black petrel population in this area is estimated at 3250 birds. This is made up of 1250 breeding pairs (i.e. 2500 birds) and 750 non-breeding birds (Table 5). The number of non-breeding birds is likely to be a minimum estimate since they migrate to South America during March. The grids were increased to 1600 m² in April from the original 400 m² and any non-breeders present in the larger area in February would have been missing in later searches.

Also extrapolating from the census grids, the 'usable' burrow density was 125 burrows/ha. Of these, 42 burrows/ha were used for breeding, 25 burrows/ha for non-breeding and 58 were empty (i.e. a 1:1.2 ratio of

empty to occupied burrows, or 1: 1.7 ratio of non-breeder to breeder burrows). Figure 3 shows that the burrows occur in clusters (or neighbourhoods), with

TABLE 5. BLACK PETREL POPULATION ESTIMATES. TOTAL HABITAT SIZE, 30 HA.

	Density (number/ha)		Population estimate	
	Breeder	Non-breeder	Breeder	Non-breeder
Kauri Dam	50	19	500	190
Palmer	44	31	440	310
South Fork	31	25	310	250
Total	125	75	1250	750
Grand total (Breeders and non-breeders)			3250	

large gaps between groups of burrows. This was also noted during preliminary surveys around Hirakimata (Figure 5). It was noted that there were zones within the 30 square hectare summit area that were not used for breeding. Black petrel burrows are usually found in cool, easily accessible areas with deep, friable soil, and several places around the summit are unsuitable because of shallow soil or rock. This preference for certain areas explains the clusters or 'neighbourhoods' of burrows.

Rat numbers were high, rats being seen during the day and trapped at night. During February, eight rats were caught over nine nights and, in April, nine over 13 nights. The ship rat, *Rattus rattus*, was the only species caught. Three rats (two males and a female) were dissected. The stomachs contained vegetable

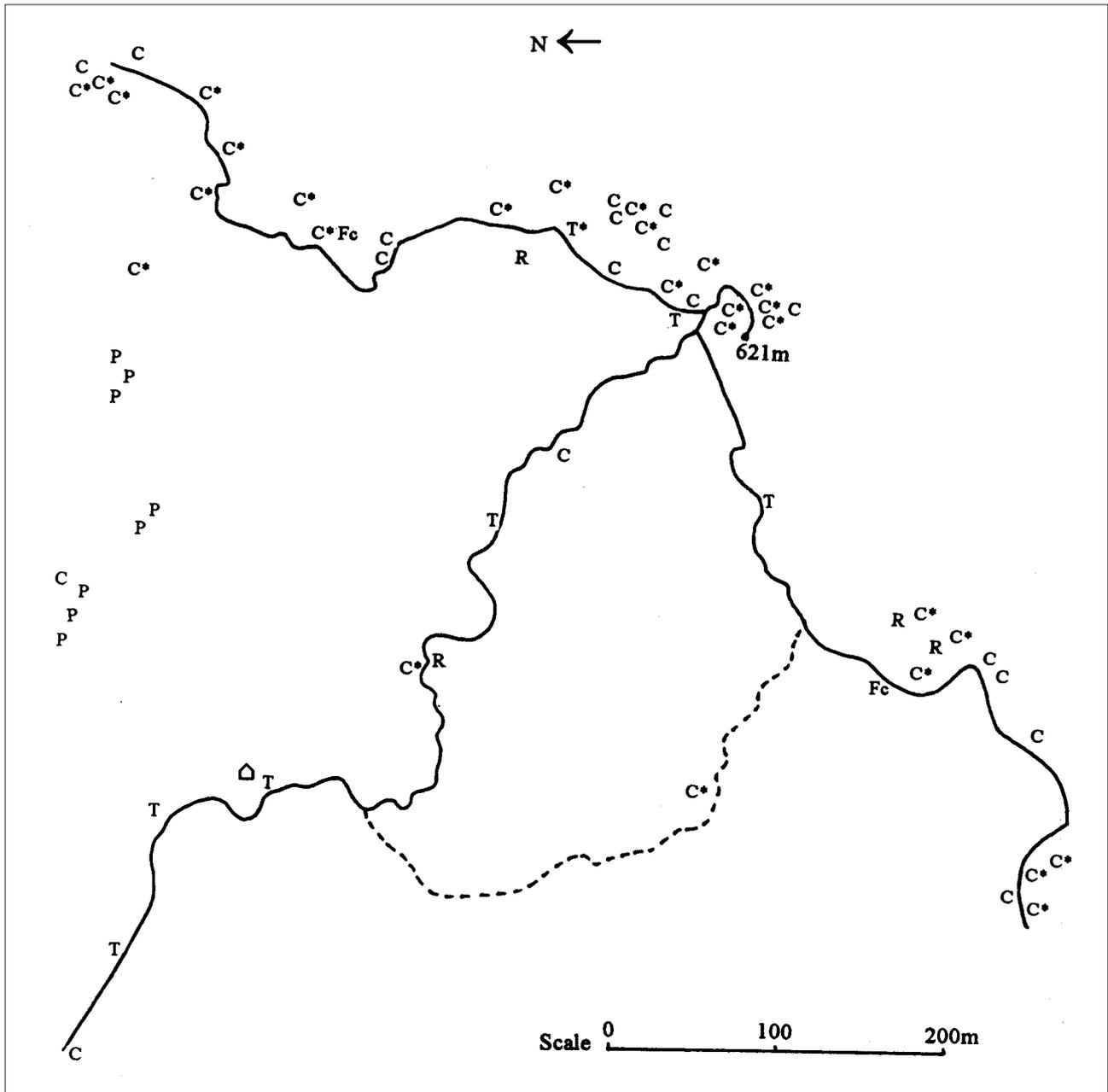


FIGURE 5. LOCATION OF CHICKS IN NON-STUDY BURROWS, CAT TRAPS, PREDATION BY RATS AND FERAL CATS, AND PIG ROOTING. C, CHICK OUT OF REACH; C*, CHICK BANNED; T, CAT TRAP; T*, CAUGHT CAT; Fc, FERAL CAT PREDATION; R, RAT PREDATION; P, PIG ROOTING.

matter and several parasitic worms (up to 15 in one stomach). No feral cats or cat sign were seen, but a female wild-type tabby (*Felis catus*) was caught during February (Figure 5). A large rat and numerous parasitic worms were found in the stomach. The cat was lactating, so probably had kittens locally. In April, the predated corpses of two Cook's petrel (*Pterodroma cooki*) were found in the summit area (Figure 5). Wild pig (*Sus scrofa*) rooting was seen along a ridge (above 400 m) opposite the DoC hut site (Figure 5). This was at a higher altitude than previously seen by local DoC staff.

Numerous people visit Hirakimata over the black petrel breeding season. During the three-week study period in February, there were 259 visitors (with high numbers on Waitangi Day), and in April there were 250 people, most (192) visiting over the Easter break. The petrels did not appear to be disturbed by the high numbers of visitors, even those with burrows directly adjacent to the track. Most birds were vocal during February, many answering to tourist footsteps. However, in April, the chicks were very quiet (even when prodded). The main problem generated by the visitors was the amount of litter and human waste around the area (especially near the summit), with some litter and toilet paper found pushed inside burrows.

5. Discussion

In the Great Barrier black petrel breeding area, the establishment of three census areas has shown that the burrows are in definite clusters (Figure 3). Generally these burrows are in optimum habitat, with friable soil in easily accessible areas, with a close 'launch site', although some birds walk great distances to good take-off places. In February, burrows were occupied at a similar ratio to those found in previous studies. Imber (1987) and Scofield (1989) both had ratios of approximately 1:1 empty to occupied burrows. However, for this study, the 1:1.2 ratio may have been affected by the possible underestimate of non-breeder burrow numbers through the grids not being increased in area until April after the non-breeder birds had left Great Barrier Island. A more accurate estimate of burrow use will be obtained from the next breeding season.

Although the ratio of non-breeding burrows to breeding burrows was 1:1.7, which is lower than was found by Imber (1987) and Scofield (1989), from use all the potential burrows within the census grids, every breeding burrow was found to be successful, i.e. all eggs hatched and all chicks were present at the end of the April visit, hence probably fledged. This means overall breeding success was 100% compared with 50% in 1977, 60% in 1978 (Imber 1987) or 62% in 1988-89 (Scofield 1989). However, 20 burrows per census grid means that the sample size is not statistically sound. The current year may have been a good breeding year despite fewer breeding adults, and later seasons may have more breeding individuals.

Adult black petrels were caught at several launch sites as well as those present in the study burrows. Sixteen adults were already banded and the 37 previously

unbanded adults were banded. All 53 birds were weighed. The average adult weight was 728 g (compared with 770 g from Scofield 1989). This weight is low because incubation periods reduced overall bird weights. From all the study burrows, 40 had chicks present. Some burrows were inaccessible, so only 31 chicks were banded and weighed. During preliminary searches around Hirakimata, 28 chicks were also banded. The average pre-fledging weight of chicks was 1069 g. This is lighter than Scofield's maximum average weight from the 1988-89 season (i.e. 1201 g), but our average weight was taken from a single occasion from a range of chick development stages rather than a continuous weighing regime over the entire growth period.

The first fully feathered chick was located on 8 April, with another on 9 April. These chicks would be ready to fledge after losing more weight. The first chick was still present a week later, but would have left very soon after this date. These chicks would have been among the first to fledge (late April).

A few burrows within the census areas and surrounding habitat had petrel bones in, or close by, the entrances. These may have been abandoned burrows (although one had a chick present this season), or they may have been burrows that were being excavated by new breeders who removed old bones when digging, or they may be evidence of previous predation events.

To gain a better idea of mortality, survivorship, productivity and breeding success, each burrow must be accessible to ensure occupancy can be determined and any adults, eggs, and chicks present can be monitored at each stage of the breeding cycle. To assist with this, the burrows should be modified with view holes or access tunnels. Many of the present study burrows could be altered without much trouble.

Among all the study burrows (including 'alphabet') only one had been predated by rats and one had an egg abandoned (5% total breeding failure), although rat predation was noted in four other burrows. This breeding failure rate is the same as found by Imber (1987) and half that of Scofield (1989). Although this is only a small percentage, rat predation could become much greater if the rat population continues to increase around the summit area.

Rats were seen on several occasions in the daytime and 17 rats were caught over both visits (in 22 nights). Scofield (1989) gave rat indices of 0.8 captures/98 trap nights (1987-88) and 1.2 captures/50 trap nights (1988-89), but we suspect these are lower than what actually occurs. A further index using techniques from Cunningham & Moors (1993) should be completed in several areas around Hirakimata.

There was no evidence of cat predation on black petrels over this breeding season, although a cat was trapped just below the summit in February (Figure 5). Two Cook's petrel fledglings were predated by a feral cat during March (found in April), so a cat or more must have still been present around the black petrel breeding area. Constant trapping over the breeding season (especially during fledging, May to June) occurs and should continue.

Pig rooting was recorded at a higher altitude than previously known by other studies and the local DoC staff (Figure 5). It is important to monitor the wild pig

population range and ensure they do not spread too far into the black petrel breeding area, as pigs can root up burrows and eat eggs, chicks, and adults.

Regardless of high numbers of visitors to the black petrel breeding area, there was little human impact on the breeding success. The construction of raised walkways around the summit has decreased damage to the environment and as such, to the burrows. Extra walkway construction is recommended, particularly on Palmer's (Windy Canyon) and Kauri Dam Tracks where erosion has increased down the tracks. In some areas, especially Palmer's Track, there may be a need to build the walkway around specific successful breeding burrows. These can be marked and avoided by the construction team. The walkway does enable easier access into the area for more visitors, but also minimises impact on the area and causes no adverse effects on the black petrels. More interpretive material around the summit area (perhaps sited on the summit platform) would educate visitors about the habitat and black petrels, and deter them from littering and fouling the area.

Although fishery observers have recorded incidental capture of seabirds during the long-line fishery activity (April to August each year), most have been albatrosses or mollymawks. High numbers of petrels (predominantly grey petrels, *Procellaria cinerea*) were caught at night northeast of New Zealand, with the highest capture rates occurring at dawn and dusk in June to August (Murray et al. 1993). The use of squid as bait attracts the birds to follow the long-line ships, and most of the birds are reported as caught during line setting (Murray et al. 1993).

In a species with a low number of breeding adults, any by-catch will effect the total population. Black petrels predominately feed on squid and fish, with minor amounts of tunicates, crustaceans and cyclostomes in the diet (Imber 1976, 1987) and while feeding very young chicks, adults occasionally make short feeding trips (compared to the normal weekly interval between visits). Although black petrels generally feed at night, on these short range feeding trips, adults may scavenge at squid boats (Imber, 1976). Black petrels have been observed alongside oceanographic vessels northwest of Great Barrier Island (Sandy Bartle, pers. comm., Imber 1976) and scavenging squid off East Cape behind a tuna long-liner in May 1994 in ones and twos (M. Imber, pers. comm.).

Black petrel by-catch has been recorded in the domestic long-line fishing industry (Sandy Bartle, pers. comm.). In a three-week observer session in December 1994, six black petrels were caught (with two identified as males), and a photograph taken from the back of the boat shows 33 black petrels scavenging or sitting on the ocean surface. In another single incident, during a daytime set in April 1993 off Mayor Island, five adult black petrels were caught (Sandy Bartle, pers. comm.). These two examples show that, in three weeks, eleven adults were killed, with nearly another 35 birds as potential targets. These events could affect the population greatly, especially if each of those birds killed were foraging food for chicks, as they would be in February to June.

The domestic long-line industry operates during the black petrel breeding season and observer data are limited. Black petrels (like most procellariiforms) have delayed maturity, low reproduction rates and high adult survivorship, and

any change, even small, in adult survivorship will affect the population greatly (Murray et al. 1993). If large numbers of adults continue to get caught on long-lines, this species could be drastically affected. Continued study of the black petrel adult survivorship, mortality, productivity and breeding success is needed to determine the overall effects of by-catch in the long-line fishing industry.

6. Recommendations

- Monitoring of the black petrel population should continue at Great Barrier Island.
- The objectives of this study should change, to focus on determining the general population dynamics of black petrels, in particular, survivorship, mortality, and breeding success, and to determine the effects of predation, long-line fishing and other environmental factors.
- Fifty to 100 easily accessible burrows should be selected as ‘study burrows’ on which to begin collecting population dynamics information on survivorship, mortality, and breeding success. If necessary, some of the burrows already identified in this study should be excavated to enable the adults and chicks to be reached.
- The February study period should be extended to a five- to six-week session to allow a longer monitoring period (or, if necessary, a survey of the area, if a total population estimate is still required after the original objectives have been changed). The April period could be reduced to one week, as the non-breeding birds have gone, and only chicks will be present, which could be banded in a short time.
- A rat index line should be completed for several areas to determine species present, total rat densities, and densities within distinct areas.
- Cat trapping should continue constantly over the black petrel breeding season, November to June, especially during pre-laying (November) and the fledging period (May to June).
- The walkway system should be continued down Palmer’s (Windy Canyon) and Kauri Dam Tracks.

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