

4. Results

4.1 STUDY BURROWS

Of the 366 study burrows (those burrows that could be accessed to determine occupancy out of the 369 numbered burrows) in 2005/06, 257 contained breeding birds, 43 contained non-breeding birds and 66 were non-occupied (Appendix 1). There were 85 failures (e.g. loss of eggs, infertility, predation etc. before fledging, see Table 1, Appendix 1). This corresponds to a breeding success of 67% (Table 1, Appendix 1).

Data from the past nine breeding seasons (since 1997/98) show that the ratio of breeding to non-breeding burrows has averaged 3:1 (Bell & Sim 2000a, b, c, 2002, 2003a, b, 2005; Bell et al. 2007; Table 2). However, the ratio of breeding to non-breeding burrows for the 2005/06 breeding season (6:1) is much lower than the average and the percentage of non-occupied burrows was also higher than most of the previous seasons monitored (18%; Table 2, Fig. 5). The proportion of non-occupied burrows has steadily increased since the beginning of the study (Table 2, Fig. 5).

4.2 NUMBER OF BURROWS IN THE CENSUS GRIDS

A total of 148 burrows were found in the nine census grids, all save one known from previous years (Figs 2-4). The new burrow was a non-breeding burrow that was being dug out in South Fork Grid 1 (Fig. 4). Ninety-three of these burrows were used by breeding pairs, 15 were used by non-breeding adults and 40 burrows were non-occupied (Appendix 1). There were also several 'potential' burrows within the grids, which were not included in any burrow estimate. 'Potential' burrows were those which had been investigated and/or preliminarily dug out by petrels, but were not yet being used by breeding or non-breeding petrels. These potential burrows were monitored annually to check for black petrel activity.

4.3 TRANSECTS

During the 2004/05 breeding season, 26 transects had been measured and surveyed within the study area (Bell et al. 2007). Seven of these transects were resurveyed. No new burrows were located along any transect, but vegetation and terrain information was clarified. Six of the burrows located on these seven transects are now being monitored as part of the study burrow set.

In the 2005/06 breeding year, our resurveys and reanalysis of the original transect data identified four burrow density grades (with corresponding habitat types) within the study site:

TABLE 1. BREEDING SUCCESS AND CAUSES OF MORTALITY IN THE BLACK PETREL (*Procellaria parkinsoni*) STUDY BURROWS ON GREAT BARRIER ISLAND (AOTEA ISLAND) BETWEEN THE 1996/97 AND 2005/06 BREEDING SEASONS.

	YEAR								
	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06
Number of study burrows	137	197	248	255	283	318	324	362	366
Eggs									
laid	95	142	178	168	192	199	208	226	257
predated (rat)	1	2	9	6	5	1	2	3	15
crushed ^a	0	1	10	6	5	14	13	7	27
abandoned	1	5	1	3	9	7	0	3	1
infertile	4	12	6	8	3	2	7	4	0
dead embryo (at various stages)	8	6	13	9	14	19	16	12	9
disappeared ^b	0	0	0	0	11	3	0	5	19
unknown fate ^c	0	0	0	0	0	5	0	0	0
Chicks									
hatched	81	116	139	136	145	148	170	192	186
predated (rat)	0	2	0	0	0	0	0	0	0
predated (cat)	0	2	2	1	2	3	2	0	2
died (disease)	0	0	0	0	0	0	0	0	0
died (starvation)	1	0	0	0	0	0	0	0	0
died (unknown causes)	0	3	6	7	8	8	10	7	12
disappeared	0	0	0	0	0	0	0	4 ^d	0
fledged ^e	80	109	131	128	135	137 ^f	158 ^g	181 ^h	172 ⁱ
Overall breeding success ^j (%)	84	77	74	76	70	69	76	80	67

^a Apparently crushed accidentally by the parents or during fighting with interloping birds and only shell fragments were recovered from the burrow. However, some may have been predated by rats, infertile, contained an embryo which died or eggs may have been crushed when adults were handled.

^b These eggs were present in November/December, but were gone when burrows were first checked in January. Many of the burrows had been cleaned out by birds and the adults were not seen again that season.

^c There were five burrows not located in May 2003 and as a result it is not known if the eggs hatched successfully. To determine overall breeding success, we have conservatively assumed that they failed.

^d These chicks were present in February 2004, but were gone in April 2004. The chicks were too young to have fledged. Some may have been predated by rats or cats, or died due to starvation or disease and been removed from the burrow by their parents.

^e All chicks still present at the end of the April trip. It is assumed that all fledged safely.

^f Of these, 78 chicks had already fledged prior to the banding visit, only 59 chicks were banded.

^g Of these, 50 chicks had already fledged prior to the banding visit, only 108 chicks were banded.

^h Of these, 6 chicks had already fledged prior to the banding visit, only 175 chicks were banded.

ⁱ Of these, 8 chicks had already fledged prior to the banding visit, 143 of the remaining 164 chicks were banded (due to a lack of bands).

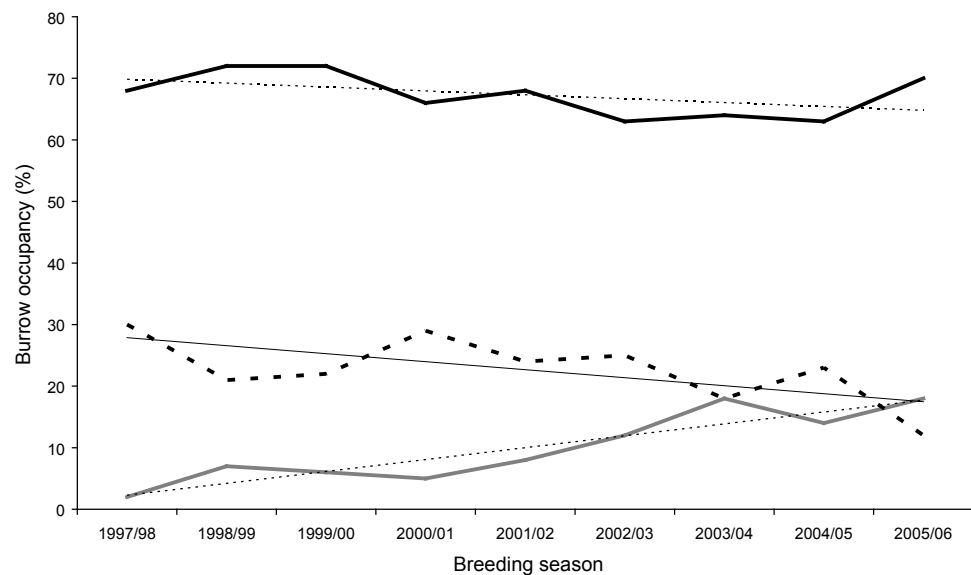
^j Percentage chicks fledged from number of eggs laid.

- High-grade petrel habitat on ridges or spurs, usually in established canopy, with high burrow density (≥ 100 burrows/ha)
- Medium-grade petrel habitat on steep slopes, usually in established canopy or tall secondary growth, with medium burrow density (50–99 burrows/ha)
- Low-grade petrel habitat, on low slopes or flat ground, often boggy, with low burrow density (1–49 burrows/ha)
- Non-petrel habitat, on stream beds, cliffs, slips and swampy areas with scrub or *Garnia*, with no burrows

TABLE 2. PROPORTIONS OF BREEDING, NON-BREEDING, OCCUPIED AND NON-OCCUPIED BLACK PETREL (*Procellaria parkinsoni*) BURROWS, AND RATIOS OF OCCUPIED TO NON-OCCUPIED BURROWS AND BREEDING TO NON-BREEDING BURROWS WITHIN THE STUDY BURROWS ON GREAT BARRIER ISLAND (AOTEA ISLAND) SINCE THE 1997/98 BREEDING SEASON.

	OCCUPIED (%)	NON-OCCUPIED (%)	RATIO OCCUPIED: NON-OCCUPIED	BREEDING BURROWS (%)	NON-BREEDING BURROWS (%)	RATIO BREEDING: NON-BREEDING
1997/98	98	2	49:1	68	30	2:1
1998/99	93	7	13:1	72	21	3:1
1999/00	94	6	16:1	72	22	3:1
2000/01	95	5	19:1	66	29	2:1
2001/02	92	8	12:1	68	24	3:1
2002/03	88	12	7:1	63	25	2.5:1
2003/04	82	18	5:1	64	18	3.5:1
2004/05	86	14	6:1	63	23	3:1
2005/06	82	18	5:1	70	12	6:1
Mean (± SEM)	90 (± 2)	10 (± 2)	15:1 (± 4)	67 (± 1)	23 (± 2)	3:1 (± 0.4)

Figure 5. Occupancy of study burrows (1997/98 to 2005/06 breeding years) by black petrels (*Procellaria parkinsoni*) on Great Barrier island (Aotea Island). Solid black line = burrows used by breeding birds; solid grey line = unoccupied burrows and dashed line = burrows used by non-breeding birds; lighter dashed lines show linear trend.



Using Manifold™, vegetation and terrain survey data and ranking transects, the two-dimensional area for each of the habitat types in the 35-ha study area was found to be 7 ha of high-grade petrel habitat, 17 ha of medium-grade petrel habitat, 10 ha of low-grade petrel habitat and 1 ha of non-petrel habitat (Fig. 6).

4.4 BANDING DATA

There were 485 adults identified during the 2005/06 season, with 377 already banded and 108 banded this season (Table 3). There were 164 chicks still present in the study burrows, but because the number of bands available on the island was underestimated, only 143 chicks were banded (Table 3, Appendix 1). The chicks were in very good condition, with many ready to fledge. Eight chicks had already fledged.

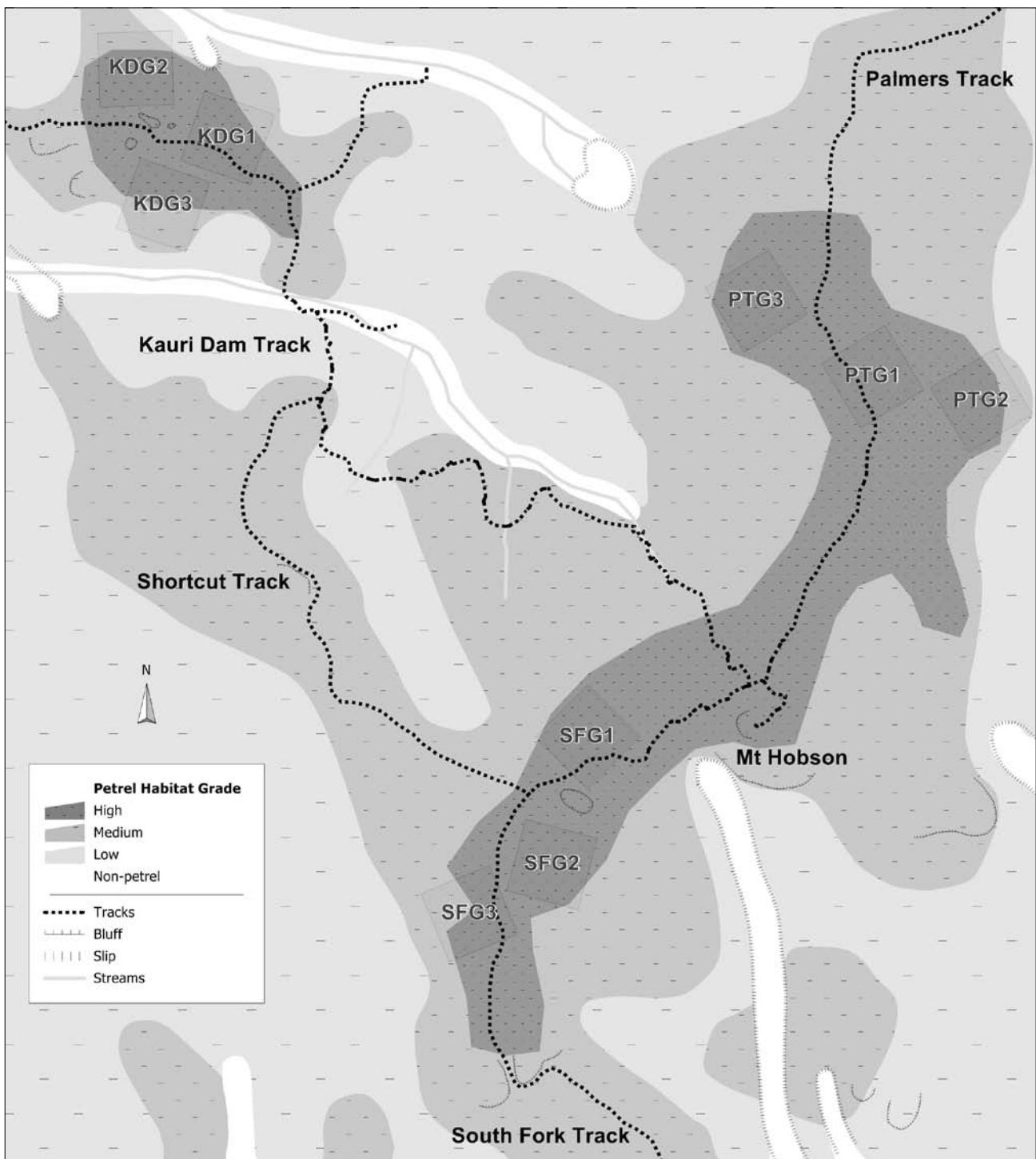


Figure 6. Habitat grades, based on black petrel (*Procellaria parkinsoni*) burrow density (incorporating habitat characteristics), within the 35-ha study site on Great Barrier Island (Aotea Island). There are 7 ha of high-grade petrel habitat, 17 ha of medium-grade petrel habitat, 10 ha of low-grade petrel habitat and 1 ha of non-petrel habitat.

There have been 1265 chicks banded within the study site between 1995 and 2006 (Table 3). These birds have begun to return to the colony as pre-breeders, non-breeder and breeders. The first returned chick (banded in the 1995/96 season) was recaptured as a pre-breeder in the 1999/00 season. Since the 1999/00 season, 50 returned chicks have been recaptured (some more than once) in subsequent years (Tables 3 & 4). While the youngest age at first recapture is 3 years, the mean (\pm SEM) age at first recapture is 5.0 ± 0.2 (Table 4). Twenty-four of these birds

TABLE 3. BANDING, RECAPTURE AND RECOVERY DATA FROM ALL BLACK PETRELS (*Procellaria parkinsoni*) CAUGHT WITHIN THE STUDY SITE ON GREAT BARRIER ISLAND (AOTEA ISLAND) FOR THE BREEDING SEASONS 1995/96 TO 2005/06.

	YEAR										
	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06
Recaptures of birds banded prior to 1995	19	31	24	23	29	27	27	27	21	22	22
Recaptures of birds banded in 1995/96	-	14	14	14	16	14	11	12	12	8	12
Recaptures of birds banded in 1996/97	-	-	113	86	84	73	63	57	43	37	39
Recaptures of birds banded in 1997/98	-	-	-	32	32	30	28	24	18	27	18
Recaptures of birds banded in 1998/99	-	-	-	-	95	82	71	64	49	36	39
Recaptures of birds banded in 1999/00	-	-	-	-	-	86	75	66	47	51	52
Recaptures of birds banded in 2000/01	-	-	-	-	-	-	51	52	41	22	36
Recaptures of birds banded in 2001/02	-	-	-	-	-	-	-	68	88	26	25
Recaptures of birds banded in 2002/03	-	-	-	-	-	-	-	-	61	55	57
Recaptures of birds banded in 2003/04	-	-	-	-	-	-	-	-	-	22	28
Recaptures of birds banded in 2004/05	-	-	-	-	-	-	-	-	-	-	48
Total recaptures	19	45	151	155	256	312	326	370	380	306	377
Number of new adults (banded that season)	41	179	60	129	145	97	114	179	67	135	108
Total adults	60	224	211	284	401	409	440	549	447	441	485
Number of chicks (banded that season)	59	69	85	116	137	137	160	62	110	184	143
Total number of birds	119	293	296	400	538	546	600	611	557	625	627
Number of returned chicks from each cohort year that have been recaptured alive at the study site in the 2005/06 season	3	6	10	14	12	3	2	0	0	0	0
Band recoveries from dead birds	-	1	1	-	2	1	2	2	-	-	2

have attempted to breed over five seasons (2000/01 to 2005/06; Bell & Sim 2002, 2003a, b, 2005; Bell et al. 2007), with 15 breeding successfully over that period. Of the 27 birds that returned in the 2005/06 season, 15 attempted to breed, with 10 successfully raising chicks of their own. The age at first breeding ranges from 5 to 9 years (Mean \pm SEM = 5.9 ± 0.2 ; Table 4) and the age at first successful breeding also ranges from 5 to 9 years (Mean \pm SEM = 6.1 ± 0.3 ; Table 4). The remaining birds have not bred, although several males were recaptured while calling to attract a mate.

Of the 27 returned chicks, four were recaptured in their natal burrows, 16 in their natal area (< 50 m from their natal burrow) and other six chicks were caught > 100 m away from their natal areas.

An immigration event was recorded for the first time in 2005/06, as a chick (H30807) banded on Hauturu/Little Barrier Island in the 1996/97 breeding season (by Reg Cotter; Mike Imber, DOC, pers. comm. 2005) was recaptured as a breeding adult on Great Barrier Island (in burrow 243, successfully raising a chick, Appendix 1).

TABLE 4. NUMBER OF RECAPTURES, AGE AT FIRST RECAPTURE, AGE AT FIRST BREEDING AND AGE AT FIRST SUCCESSFUL BREEDING FOR $n = 50$ BLACK PETRELS (*Procellaria parkinsoni*) BANDED AS CHICKS AND RECAPTURED IN THE STUDY SITE ON GREAT BARRIER ISLAND (AOTEA ISLAND) WITH A NOTE ABOUT AN IMMIGRANT BANDED AS A CHICK ON HAUTURU/LITTLE BARRIER ISLAND.

BAND	SEX	SEASON BANDED	SEASON WHEN LAST RECAPTURED	NUMBER OF RECAPTURES	AGE AT FIRST RECAPTURE (YEARS)	AGE AT FIRST BREEDING (YEARS)	AGE AT FIRST SUCCESSFUL BREEDING (YEARS)
H25525	Male	1998/99	2005/06	1	7	-	-
H25536	Male	1998/99	2005/06	2	6	-	-
H25546	Male	1998/99	2005/06	3	5	5	7
H25630	Male	1999/00	2005/06	2	5	-	-
H25631		1999/00	2003/04	1	4	-	-
H25635	Male	1999/00	2005/06	2	5	6	-
H25637	Male	1999/00	2004/05	1	5	-	-
H25648	Male	1999/00	2005/06	2	5	-	-
H25651	Male	1999/00	2005/06	2	5	6	-
H25658	Male	1999/00	2004/05	1	5	-	-
H25659	Female	1999/00	2005/06	1	6	6	6
H25663	Male	1999/00	2005/06	3	4	-	-
H25664	? Female	1999/00	2005/06	3	3	6	-
H25669	Male	1999/00	2005/06	2	5	5	5
H25673	Male	1999/00	2005/06	2	5	5	-
H28085	Male	1998/99	2005/06	1	7	-	-
H29912	? Male	2000/01	2005/06	1	5	5	-
H30908	? Male	1995/96	2002/03	1	7	-	-
H30924	Male	1995/96	2005/06	5	6	6	6
H30930	Male	1995/96	2005/06	7	4	5	5
H31076		1997/98	2002/03	1	5	-	-
H31080		1997/98	2001/02	1	4	-	-
H31081	? Male	1997/98	2002/03	2	4	-	-
H31082	Male	1997/98	2001/02	1	4	-	-
H31089		1997/98	2003/04	2	5	6	-
H31194	Male	1996/97	2001/02	1	5	5	5
H31366	? Male	1997/98	2005/06	4	5	6	6
H31370	? Male	1997/98	2005/06	2	5	8	-
H31377	? Male	1997/98	2001/02	1	4	-	-
H31382	Female	1997/98	2003/04	3	4	5	5
H31383	Male	1997/98	2003/04	1	6	6	6
H31405		1996/97	2004/05	3	6	7	8
H31406	? Female	1996/97	2001/02	1	5	-	-
H31413	? Female	1996/97	2004/05	1	5	5	5
H31415		1996/97	2004/05	1	8	-	-
H31424	? Male	1996/97	2005/06	4	6	8	8
H31474	? Male	1998/99	2002/03	1	4	-	-
H31476	Male	1998/99	2004/05	2	4	6	-
H31490	? Male	1998/99	2002/03	1	4	-	-
H31491	Male	1998/99	2005/06	1	7	-	-
H31494	Male	1998/99	2004/05	1	6	-	-
H31495	? Male	1998/99	2005/06	4	4	6	6
H31498	? Female	1998/99	2004/05	1	6	6	-
H31527	? Male	1998/99	2002/03	1	4	-	-
H31536		1998/99	2003/04	1	5	-	-
H31542	Male	1998/99	2005/06	4	4	6	7
H32063		2000/01	2005/06	1	5	-	-
H32099	? Male	2000/01	2005/06	1	5	-	-
H32980	? Male	2001/02	2005/06	1	4	-	-
H33088		2001/02	2005/06	1	3	-	-
Mean (\pm SEM)				1.9 \pm 0.2	5.0 \pm 0.2	5.9 \pm 0.2	6.1 \pm 0.3
H30807 ^a	Female	1996/97	2005/06	1	9	9	9

^a Immigrant originally banded on Hauturu/Little Barrier Island, but now breeding successfully on Great Barrier Island (Aotea Island).

4.5 POPULATION ESTIMATES

Extrapolation from the census grid data to the 35-ha study site around the summit area of Mount Hobson, gives an estimate of the 2005/06 burrow-occupying black petrel population to be between 4008 and 5946 adults (Mean \pm SEM = 4977 ± 969 birds; Table 5), consisting of 460 (± 151) non-breeding adults and 4517 (± 818) breeding adults (i.e. approximately 2250 breeding pairs).

Extrapolation from the transects to the 35-ha study site around the summit area of Mount Hobson gives an estimate of the 2005/06 burrow-occupying black petrel population of between 3876 and 4816 adults (4346 ± 470 birds; Table 6), consisting of 1003 (± 153) non-breeding adults and 2583 (± 317) breeding adults (i.e. approximately 1290 breeding pairs).

The third estimate involved extrapolation from the transects, with stratification of the 35-ha study area into the four habitat grades based on burrow density (see Section 4.3). This method produced an estimate for the 2005/06 burrow-occupying black petrel population of between 3154 and 4054 adults (3604 ± 450 birds, Table 7), consisting of 1009 (± 162) non-breeding adults and 2595 (± 288) breeding adults (i.e. approximately 1300 breeding pairs).

4.6 SURVIVAL ESTIMATES

We ran a Cormack Jolly Seber (CJS) analysis (adult survival and probability of recapture (varying over time) model: $\Phi(t)P(t)$ with $AICc = 3430.3$; $Chat = 1.73$) of all adults recaptured between 1995/96 and 2005/06. This generated a mean adult apparent survival of $0.7923 (\pm 0.03)$, but there is a suggestion of a slight increase in adult apparent survival over the study period (Table 8). The mean probability of recapture from one year to the next was 0.7836 ± 0.03 (Table 8).

TABLE 5. 2005/06 POPULATION ESTIMATE OF BLACK PETRELS (*Procellaria parkinsoni*) IN THE 35-ha STUDY SITE AROUND MOUNT HOBSON, GREAT BARRIER ISLAND (AOTEA ISLAND), EXTRAPOLATING FROM CENSUS GRIDS ONLY.

GRID	DENSITY (NUMBER/ha)		POPULATION ESTIMATE (35 ha)	
	BREEDING ADULTS	NON-BREEDING ADULTS	BREEDING ADULTS	NON-BREEDING ADULTS
Grid One (KDG1)	250	16	8750	560
Grid Two (KDG2)	187.5	31.25	6562.5	1094
Grid Three (KDG3)	50	8	1750	280
Grid Four (PTG1)	200	31.25	7000	1094
Grid Five (PTG2)	112.5	8	3937.5	280
Grid Six (PTG3)	87.5	0	3062.5	0
Grid Seven (SFG1)	136.5	23	4777.5	805
Grid Eight (SFG2)	87.5	0	3062.5	0
Grid Nine (SFG3)	50	0	1750	0
Mean (\pm SEM)	129 \pm 23	13 \pm 4	4517 \pm 818	460 \pm 151
Total population estimate	4977 \pm 969			
Population estimate range	4008 to 5946 adults			

TABLE 6. 2005/06 POPULATION ESTIMATE OF BLACK PETRELS (*Procellaria parkinsoni*) IN THE 35-ha STUDY SITE AROUND MOUNT HOBSON, GREAT BARRIER ISLAND (AOTEA ISLAND), EXTRAPOLATING FROM TRANSECTS ONLY.

TRANSECT	DENSITY (NUMBER/ha)		POPULATION ESTIMATE (35 ha)	
	BREEDING ADULTS	NON-BREEDING ADULTS	BREEDING ADULTS	NON-BREEDING ADULTS
1	76	31	2660	1085
6	77	73	2695	2555
7	0	16	0	560
8	76	24	2660	840
9	63	49	2205	1715
10	176	48	6160	1680
11	38	8	1330	280
12	53	25	1855	875
13A	100	63	3500	2205
14	73	0	2555	0
15	84	26	2940	910
16	46	0	1610	0
17	100	24	3500	840
18	63	31	2205	1085
19	0	0	0	0
20	53	33	1855	1155
24	84	18	2940	630
25	113	70	3955	2450
26	138	33	4830	1155
31	30	0	1050	0
37	200	41	7000	1435
38	63	16	2205	560
40	46	58	1610	2030
41	88	48	3080	1680
93	47	0	1645	0
97	32	10	1120	350
Mean (\pm SEM)	74 \pm 9	29 \pm 4	2583 \pm 317	1003 \pm 153
Total population estimate (\pm SEM)				4346 \pm 470
Population estimate range				3876 to 4816 adults

A CJS analysis of 421 birds of known sex suggested that there was no significant difference between male and female adult survival, as the best adult survival model was also $\Phi(t)P(t)$ compared with the model $\Phi(\text{sex})P(t)$ (which is adult survival and probability of recapture (varying with sex and over time) where Φ = apparent survival, sex = sex of the bird, t = time, P = probability of recapture).

The multi-state model to determine the probability of transition from one state to another showed that there is a probability of approximately 0.08 (i.e. about an 8% chance) of either a successful breeder or an unsuccessful breeder changing to a non-breeder (i.e. skipping a year in breeding; Table 9). However, if a bird does skip a year, it is more likely to be a successful breeder in the following year ($P = 0.4935 \pm 0.02$ compared with 0.313 ± 0.02). A model where the probability of transition (ψ) from breeder to non-breeder varied with time was less parsimonious (the likelihood value (ΔAICc) = 2.1).

TABLE 7. 2005/06 POPULATION ESTIMATE OF BLACK PETRELS IN THE 35-ha STUDY AREA AROUND MOUNT HOBSON, GREAT BARRIER ISLAND AFTER STRATIFYING AND GRADING THE TRANSECTS. [AREA OF EACH BURROW DENSITY GRADE IS 7 ha OF HIGH GRADE PETREL HABITAT, 17 ha OF MEDIUM PETREL HABITAT, 10 ha OF POOR PETREL HABITAT AND 1 ha OF NON-PETREL HABITAT].

GRADE	TRANSECT	BURROW DENSITY (per ha)				AREA (ha)	BURROW DENSITY		POPULATION ESTIMATE	
		BREEDING BURROW	NON-BREEDING BURROW	NON-OCCUPIED BURROW	BREEDING BURROW		NON-BREEDING BURROW	BREEDING ADULTS (2 per burrow)	NON-BREEDING ADULTS (1.25 per burrow)	
Low (1-49 burrows/ha)	7	0	13	13	0	10	0	130	0	163
	11	19	6	0	190	60	380	75	250	75
	12	26	20	0	260	200	720	460	0	0
	14	36	0	0	360	0	0	0	0	0
	16	23	0	23	230	0	0	0	0	0
	19	0	0	0	0	0	0	0	0	0
	31	14	0	0	140	0	280	460	0	0
	93	23	0	0	230	0	460	320	100	65 (± 30)
	97	16	8	0	160	80	320	349 (± 78)	65 (± 30)	
		Mean (± SEM)	17 (± 4)	5 (± 2)	4 (± 3)	174 (± 39)	52 (± 24)	349 (± 78)	65 (± 30)	
Medium (50-99 burrows/ha)	1	38	25	0	646	425	1292	531	1232	1232
	6	38	58	0	646	986	1292	404	829	446
	8	38	19	6	646	323	1292	1700	531	553
	9	31	39	0	527	663	1054	884	298	276
	15	42	21	0	714	357	1428	782	978	595
	17	50	19	0	850	323	1700	1230 (± 78)	590 (± 83)	
	18	31	25	0	527	425	1054	700	333	438
	20	26	26	0	442	442	884	784	490	219
	24	42	14	0	714	238	1428	1400	289	
		Mean (± SEM)	36 (± 2)	29 (± 4)	2 (± 1)	615 (± 39)	472 (± 66)	1230 (± 78)	590 (± 83)	
High (≥ 100 burrows/ha)	10	88	38	0	616	266	1232	333	438	490
	13A	50	50	17	350	350	700	966	1400	289
	25	56	56	13	392	392	784	1016 (± 132)	354 (± 49)	
	26	69	25	6	483	175	966	2595 (± 288)	1009 (± 162)	
	37	100	33	0	700	231	1400	3604 (± 450)		
	Mean (± SEM)	73 (± 10)	40 (± 6)	7 (± 3)	508 (± 66)	283 (± 39)	1016 (± 132)	354 (± 49)		
Population estimate (± SEM)		2595 (± 288)								
Population estimate (± SEM)		3604 (± 450)								
		= 3154 to 4054 individuals								

TABLE 8. ADULT SURVIVAL ESTIMATES FROM CORMACK JOLLY SEBER ANALYSIS USING PROGRAM MARK (WITH STANDARD ERRORS AND 95% CONFIDENCE INTERVALS) AND PROBABILITY OF RECAPTURE FOR BLACK PETRELS (*Procellaria parkinsoni*) ON GREAT BARRIER ISLAND (AOTEA ISLAND).

PARAMETER	ESTIMATE	SE	95% CI (LOWER)	95% CI (UPPER)
Survival 1995/96–1996/97	0.6427	0.0960	0.4421	0.8031
Survival 1996/97–1997/98	0.8131	0.0445	0.7103	0.8854
Survival 1997/98–1998/99	0.7124	0.0435	0.6204	0.7896
Survival 1998/99–1999/00	0.8693	0.0284	0.8031	0.9156
Survival 1999/00–2000/01	0.8489	0.0265	0.7894	0.8938
Survival 2000/01–2001/02	0.8334	0.0277	0.7719	0.8808
Survival 2001/02–2002/03	0.7947	0.0273	0.7361	0.8430
Survival 2002/03–2003/04	0.7525	0.0293	0.6907	0.8054
Survival 2003/04–2004/05	0.9117	0.0433	0.7823	0.9674
Survival 2004/05–2005/06	0.7440	-	-	-
Mean	0.7923	± 0.0254		
Probability of recapture 1995/96–1996/97	0.6439	0.1141	0.4054	0.8274
Probability of recapture 1996/97–1997/98	0.7599	0.0481	0.6537	0.8415
Probability of recapture 1997/98–1998/99	0.8198	0.0403	0.7272	0.8859
Probability of recapture 1998/99–1999/00	0.9071	0.0253	0.8443	0.9462
Probability of recapture 1999/00–2000/01	0.8495	0.0274	0.7876	0.8958
Probability of recapture 2000/01–2001/02	0.8428	0.0276	0.7810	0.8896
Probability of recapture 2001/02–2002/03	0.9184	0.0214	0.8655	0.9516
Probability of recapture 2002/03–2003/04	0.7181	0.0322	0.6510	0.7768
Probability of recapture 2003/04–2004/05	0.6024	0.0383	0.5254	0.6745
Probability of recapture 2004/05–2005/06	0.7736	-	-	-
Mean	0.7836	± 0.033		

TABLE 9. ESTIMATES (AND STANDARD ERRORS) OF THE PROBABILITY OF EACH BLACK PETREL (*Procellaria parkinsoni*) CHANGING BREEDING STATE FROM ONE YEAR TO THE NEXT IN THE 35-ha STUDY SITE ON GREAT BARRIER ISLAND (AOTEA ISLAND).

PARAMETER	ESTIMATE	SE	95% CI	95% CI
Transition probability of going from unknown to any other state (except chick)	0.1200	0.0193	0.0871	0.1632
Transition probability of going from any other state (except chick) to unknown	0.0043	0.0013	0.0024	0.0078
Transition probability of going from a breeder to failed breeder	0.1714	0.0096	0.1534	0.1910
Transition probability of going from a breeder to non-breeder	0.0846	0.0071	0.0717	0.0997
Transition probability of going from a failed breeder to breeder	0.6104	0.0231	0.5642	0.6548
Transition probability of going from a failed breeder to non-breeder	0.0834	0.0134	0.0607	0.1137
Transition probability of going from a chick to any other state	0.0110	0.0016	0.0083	0.0146
Transition probability of going from a non-breeder to breeder	0.4935	0.0249	0.4449	0.5421
Transition probability of going from a non-breeder to failed breeder	0.3132	0.0233	0.2695	0.3605