Monitoring Antipodean wandering albatross, 1997/98

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A B S T R A C T

This report describes the fifth consecutive year of study of the Antipodean wandering albatross (*Diomedea antipodensis*). Productivity for the 1997 breeding season was 81% and the average for the last four years was 77%. In 1997, 119 chicks were banded, making a total of 332 chicks banded since annual banding for assessment of recruitment began in 1995. A 3 year old chick was recovered on the island in February 1998, which established the minimum age of first return for Antipodean wandering albatross. Data on the return of banded adults to the study area enabled estimation of annual adult survival for 1994/95 and 1995/66 of 1.01 and 0.97, respectively. An area which includes about 10% of all albatross nesting on the island was permanently marked with poles, and all the albatross nests within it were counted. This area will be used for monitoring population trends. In trials of harnesses for attaching satellite transmitters, harnesses constructed of shock-cord had the least effect on albatross behaviour. Ten transmitters with a planned life of two years were attached to breeding albatross in February. All stopped transmitting between April and June 1998 because of an equipment malfunction.

Keywords: Antipodean wandering albatross, *Diomedea antipodensis*, breeding success, recruitment, adult survival, nest census, satellite tracking, at-sea distribution.

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1. Introduction

The Antipodean wandering albatross (*Diomedea antipodensis*), which is endemic to the Antipodes Islands in the New Zealand subantarctic, has been a regular bycatch on both foreign and New Zealand southern bluefin tuna fishing boats since long-lining began in the early 1960s (Murray et al. 1993). As wandering albatrosses are long-lived (> 40 years), breed late (> 10 years), and produce a chick only once every 2–3 years, the increased mortality caused by bycatch has the capacity to threaten the species.

A number of concurrent programmes are attempting to examine and resolve this issue: a variety of underwater bait-setting and other mitigation devices are being developed and tested; observers are placed on boats to accurately document the extent and patterns of bycatch; the zones of greatest potential conflict are being identified through satellite telemetry of foraging albatross; and the impact of the bycatch and any mitigation of it on albatross populations are being monitored.

Monitoring of Antipodean wandering albatrosses began in the 1993/94 season (Walker & Elliott 2002a). This report describes progress during the 1997/98 year on: the at-sea distribution of Antipodean wandering albatrosses and their population status. The population study focuses on estimating survival, productivity, and recruitment rates so that the population can be modelled and sustainable bycatch levels estimated. Population trends are also monitored

Wandering albatrosses spend most of their lives at sea, and the most economical way to assess the fisheries impact is during the short period they concentrate on small subantarctic islands to breed. Every summer just less than half of the Antipodean wandering albatrosses gather to breed, and adolescents to establish mates, on Antipodes I. (see map in Walker & Elliott 2002a, fig.1). During this period, population parameters can be assessed, and satellite transmitters can be attached to follow the birds' life at sea.

During 1997/98 there were two visits to Antipodes I. The first, from 20 to 24 November 1997, was made by Jacinda Amey and Sandra King. Transport was provided by Gerry Clarke on his small yacht *Totorore* during his 1997 Bounty I. expedition. During this visit, 1997 productivity was assessed, and all the chicks produced in 1997 in the study area were banded to allow for assessment of recruitment.

A second, much longer visit, was made from 15 January to 1 March 1998 to assess adult survival, and population changes, and to carry out trials and deployments of satellite transmitters. The team comprised Kath Walker and Graeme Elliott and transport was provided by the Wellington-based yacht *Phantom of the Straits* and the Bluff-based cargo ship *Marine Countess*.

2. Population dynamics

A population study aimed at measuring productivity, survival and recruitment has been conducted in a study area at the northern end of Antipodes I. since 1994 (see Walker & Elliott 2002a). The study area comprises about 50 ha at the northern end of Antipodes I. (Fig. 1), mostly bounded by obvious geographical features.

During the 1997/98 visit we placed white plastic electric fence poles along the less well defined of the study area boundaries (Fig. 2) to eliminate the possibility that different observers might have different ideas of where the boundaries really are.

This season we started banding birds with highly visible, coloured, plastic (darvic) numbered bands in addition to metal bands. These bands are much easier to read than metal ones and they increase the chances of reading band numbers both on land and at sea. They also reduce the amount of disturbance to study area birds since the birds do not have to be approached as closely for bands to be read. Different coloured darvic bands were used on adults and chicks to make future assessment of recruitment easier, and the colours used were different from those used on the Auckland Islands wandering albatross *D. gibsoni* to facilitate easy species differentiation at sea.

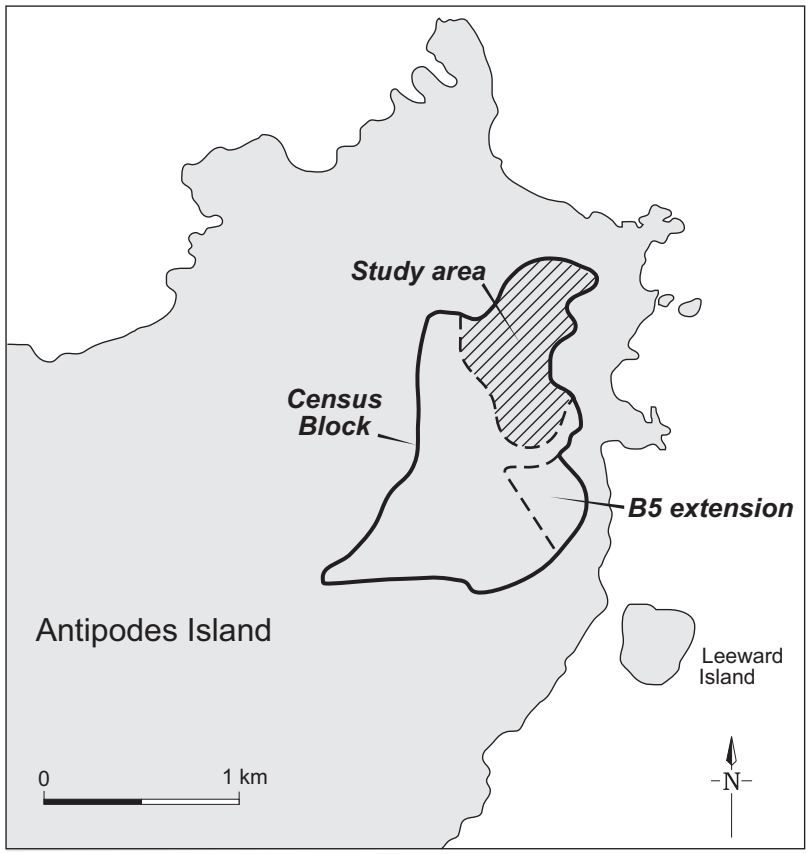

Figure 1. Study area and the marked census block on Antipodes Island. The census block is roughly the old Block 5 minus an area adjacent to the eastern coastal cliffs where the tall fern and tussock obscured the birds, making it difficult to count them.

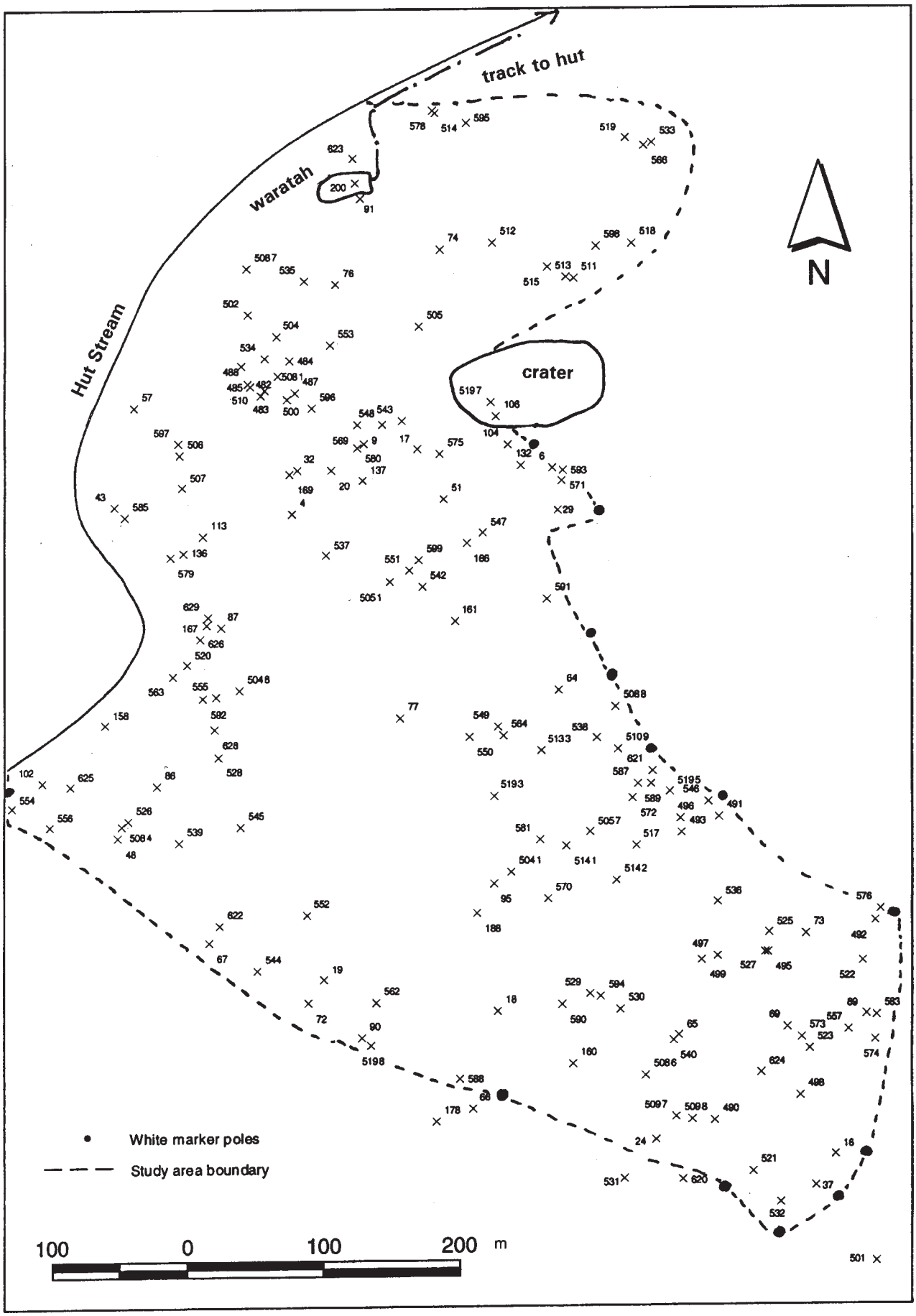

Figure 2. Antipodean wandering albatross nests in the study area on Antipodes Island, 1998.

2.1 METHODS

Between 20 and 24 November 1997, all the study area nests that had eggs in February 1997 were visited and all chicks present were banded with both numbered metal and white darvic bands.

Between 26 and 30 January 1998 we searched for all of the previous season's nests, confirmed their identity from their metal tags, and assessed their final outcome using the following criteria

Successful nests had some or all of the following signs:

- a large area of trampled and urea-burnt vegetation,
- flimsily constructed chick nests near the original nest,
- small pieces of down scattered around,
- a large and healthy chick that appeared about ready to fledge.

Unsuccessful nests had some or all of the following signs:

- large pieces of eggshell seen in or around the nest,
- nests were overgrown,
- nest had chick bones present,
- nest had a recently dead chick.

Once all the previous season's nests had been found and assessed, the metal nest tags were removed, along with those from any earlier year's nests.

Between 18 January and 28 February 1998 we made daily trips to the study area and read the bands of all banded birds encountered in or near the study area, banded any unbanded nesting birds with both metal and blue darvic bands, put blue darvic bands on any already metal-banded study area birds, checked every nest and potential nest for an egg to determine laying dates and incubation shift lengths, and marked nests with numbered metal tags and mapped their positions using compass and tape measure.

2.2 RESULTS

2.2.1 Breeding success

From 146 nests in the study area in 1997, 119 chicks were banded in November 1997, of which 118 (81%) fledged. Table 1 presents breeding success figures for the last 4 years.

In February 1998, 172 new nests were tagged and mapped (Fig. 2) and their nesting success will be assessed next summer. Five of these nests had failed before we left the island at the end of February 1998 (Appendix 1).

TABLE 1. NESTING SUCCESS IN THE STUDY AREA ON ANTIPODES ISLAND SINCE 1994.

YEAR	NO. OF NESTS MONITORED	BREEDING SUCCESS (%)
1994	110	74.8
1995	156	74.4
1996	155	78.5
1997	146	80.8
Average		77.1

2.2.2 ADULT MORTALITY

In 1998, 167 pairs of birds nested within the study area and five pairs that had previously nested and been banded in the study area nested just outside it this season. Of these, 76 were new birds that we banded for the first time, and eight were not checked for bands either because the nest failed before we had read the bands of both partners, or because we found the nest towards the end of our visit and we left the island before we had read the bands of both partners. In addition, we read the bands of 76 non-breeding birds that were visiting the study area.

We estimated adult survival using the methods of Cormack (1964, 1972), which reliably estimates annual survival only for periods more than two years before the last visit to the island (Table 2).

Two female study area birds were recovered dead after they had been caught on tuna long-lines during the winter of 1997. The chicks of these birds continued to be raised by their fathers and were small and behind in their development when we arrived at the island in January 1998, but both eventually fledged.

TABLE 2. ESTIMATED ANNUAL SURVIVAL OF ADULT ANTIPODEAN WANDERING ALBATROSSES RETURNING TO THE STUDY AREA ON ANTIPODES ISLAND. STANDARD ERRORS IN PARENTHESES.

YEAR	ALL BIRDS	KNOWN MALES	KNOWN FEMALES
1995	1.01 (0.02)	1.01 (0.01)	0.99 (0.01)
1996	0.97 (0.02)	1.01 (0.02)	1.04 (0.02)
Average	0.99 (0.03)	1.01 (0.00)	1.02 (0.04)

2.2.3 RECRUITMENT

In November 1997, 119 chicks were banded in the study area. Table 3 shows the number of chicks that have been banded on Antipodes I. for future assessment of recruitment.

TABLE 3. FLEDGLING ANTIPODEAN WANDERING ALBATROSSES BANDED ON ANTIPODES ISLAND, 1995–97.

YEAR	STUDY AREA	OUTSIDE STUDY AREA
1995[a]	116	1865
1996[b]	98	402
1997[c]	118	
Total	332	2267

[a] banded with metal bands only. [b] banded with metal and orange darvic bands. [c] banded with metal and white darvic bands.

A chick banded in October 1995 near Ringdove Stream at the southern end of Antipodes I. was found on the ground in the study area, alive and well on 16 February 1998, just less than 3 years old. This is the first indication of the minimum age of first return to the breeding island. The average age of first return is likely to be about 6 years, and the average age of recruitment to the breeding population about 11.5 years; reliable estimates of recruitment are some time off.

3. Population trends

Collecting information on population size in a deferred breeding species such as the wandering albatross is slow, since birds return to breed only once every 2–3 years. Between 1994 and 1997, a series of annual whole-island counts were carried out. Results from these show that each year an average of 5136 pairs breed on the island. Now that we have a reasonable estimate of the total population size, future counts will mostly be of only a representative portion of the island and will be intended to monitor population change rather than assess population size.

3.1 METHODS

Between 13 and 19 February 1998 a portion of the island was permanently marked and all active albatross nests within it counted. The area selected comprised part of the North Plains, including most of an area known as Block 5 (Fig.1). Most of the boundaries of this area were obvious geographical features, but where there were no such features, we placed white plastic electric fence poles at about 50 m intervals (Fig. 2). A small part of Block 5 above Alert Bay was excluded because it was mostly tall fern and tussock in which very few birds nested, but which took a long time to check thoroughly.

The boundaries of the permanently marked area are: in the east, the edge of the study area then a line of white poles up and over Clarke Hill to Dougall Stream;

the southern boundary is Dougall Stream and a gully of tall fern joining the stream from Mt Galloway; the western boundary is another gully of fern from Mt Galloway running north and supplemented by a line of five white poles as the gully ends in the central North Plains; the northern boundary is reed-like *Carex ternaria* swamp in the upper reaches of Hut Stream.

The small part of Block 5 not included in the permanently marked area was counted separately in 1998 to allow comparison of the 1998 totals with those of the previous four years.

Most wandering albatross nests on Antipodes I. are fairly evenly distributed throughout the higher-altitude, less densely vegetated parts of the island. The area chosen for counts was typical of this country and contained about 10% of the albatross nests on the island.

The block was counted by two observers walking 20 m apart, up and down the block, parallel to the longest boundary. The person on the edge of the uncounted land marked the boundary with spray paint, and the observers followed back along this line on the subsequent 'sweep'. Once a nest had been counted, a mark was made with spray paint on the ground nearby. All birds on nests were checked for bands, and all nests were checked for eggs. Birds on the ground without nests were also checked for bands. The location of all banded birds was recorded along with a Gibson Plumage Score (Gibson 1967).

Once the whole area had been counted we checked the reliability of the census by walking straight transects along compass bearings at right angles to the census sweep lines, checking all nests within 10 m of the transect for paint marks which indicated that the nests had been counted.

3.2 RESULTS

In Block 5, 543 nests were counted. Table 4 compares this count with results in the previous four years. There were 534 nests in the permanently marked part of Block 5 (Table 5), which was counted in 12 sweeps taking a total of 31 person hours. During this census we read the bands of 24 birds that had been banded on Antipodes I. before our study began, during expeditions in 1969, 1978, and 1985, and five birds that had been banded in our study area (Appendix 2).

In the transect checks, 104 nests were counted again, and four unpainted nests were found, indicating that we underestimated the number of nests in our original count by 4%. The transect counts included about 20% of all the nests in the block.

TABLE 4. ALBATROSS NESTS WITH EGGS COUNTED IN BLOCK 5 BETWEEN 1994 AND 1998.

	1994	1995	1996	1997	1998
Number of nests	553	490	425	472	543

TABLE 5. CENSUS OF ANTIPODEAN WANDERING ALBATROSS IN A PERMANENTLY MARKED AREA ON ANTIPODES ISLAND, 13–19 FEBRUARY 1998.

1997 chicks	9
Unbanded birds on eggs	511
Banded birds on eggs	23
Unbanded birds on the ground	219
Banded birds on the ground	6
Total number of banded birds	29
Total number of birds on the ground	225
Total number of nests	534

4. Monitoring at-sea distribution

4.1 HARNESS TRIALS

4.1.1 Methods

Following earlier tests (Walker & Elliott 2002b), during 1997 Kevin Lay from SIRTRACK Ltd helped us design a mechanism which would release the harness strings of a satellite transmitter when a programmable timer fired a detonator. They then fitted 10 transmitters (PTTs) with release mechanisms and made 10 dummy transmitters of the same size and weight (70 g including the harness) as the real ones.

In January 1998 we attached dummy transmitters to nine female wandering albatrosses that were incubating eggs on Antipodes I. Five were harnessed with a soft dacron braid, and four with shock-cord (bungee cord).

We weighed these birds just before they were relieved of incubation duties on their nests by their mates, and we weighed them again when they returned to the nest after foraging at sea. We compared their weight gains while foraging with those of 21 female birds not wearing satellite transmitters that we also weighed before and after their flights.

By visiting all the nests in our study area daily, we were able to compare the flight duration of the nine harnessed birds with those of 149 unharnessed birds.

4.1.2 Results

Four of the birds with soft-braid harness spent more time at sea than did birds without harnesses. The fifth bird with soft-braid harness apparently deserted and did not return to the island before our departure.

The foraging flight lengths of the four birds with shock-cord harnesses were very similar to those of birds without harnessed transmitters.

Birds with either the soft-braid or shock-cord harness put on less weight per day while foraging than did birds without transmitters, but the differences were not significant (Table 6).

TABLE 6. FLIGHT DURATIONS AND WEIGHT GAINS OF BIRDS CARRYING HARNESSED SATELLITE TRANSMITTERS AND THOSE WITHOUT TRANSMITTERS.

		SOFT-BRAID HARNESS	SHOCK-CORD HARNESS	NO HARNESS
Flight duration	Mean	21	13	13.4
(days)	Range	15–26	9.5–16	4–31
	n	4	4	149
Weight gain	Mean	0.045	0.044	0.075
(g/day)	Range	0.019–0.064	0.014–0.075	0.04–0.165
	n	4	4	21

4.2 SATELLITE TELEMETRY

Between 24 and 26 February 1998, we put 10 Microwave Telemetry 'Pico' satellite transmitters on five male and five female wandering albatrosses. All birds were incubating eggs at the time the transmitters were attached. The shock-cord harness design (see above) was used for all transmitters.

Four transmitters had two AA lithium batteries, and six had four 7PN batteries, and the two battery configurations resulted in different shaped packages and different duty cycles. The packages with two AA cells had more energy per weight than the other packages, and the only reason we did not use this configuration for all transmitters was the unavailability of sufficient suitable AA lithium cells.

The battery life of all transmitters was about 27 months, and the release mechanisms were planned to release the transmitters after 750 days. The total package, including transmitter, harness, batteries, and release mechanism weighed 70 g, which is 0.7–1.5 % of the bird's body weight. Table 7 shows the details of the birds and transmitters.

All birds left the island to forage within 12 days of the transmitters being attached. After doing their normal incubation shift, three birds apparently deserted, while the remaining seven birds made regular trips to and from the island.

The foraging ranges of the birds during March and April were very similar to those we had recorded in previous years at similar times of year. Males regularly foraged around the Chatham Is and to the south of Antipodes I., and females foraged north of the Chatham Is. However, for the first time we had transmitters on birds at about the time their eggs hatched and we observed the contraction in foraging range that has been reported in other species of wandering albatrosses.

On 18 and 19 April, after 54 days of transmission, eight of the transmitters unexpectedly stopped transmitting, and, after a further 83 and 110 days, the remaining two stopped. After about 120 days, one of the transmitters that stopped at 54 days briefly transmitted again from Antipodes I.

Examination of the program which controlled the timer showed a programming error had caused the harnesses to release prematurely after 54 rather than 750

TABLE 7. DETAILS OF SATELLITE TRANSMITTERS AND THE BIRDS THEY WERE ATTACHED TO ON ANTIPODES ISLAND 24–26 FEBRUARY 1998.

BAND NO.	BIRD NAME	SEX	NEST NO.	PTT NO.	DUTY CYCLE
47713	Polar	Male	515	6113	6 on 20.5 off
47707	Carex	Male	102	6114	6 on 20.5 off
47649	Lichen	Female	507	6115	6 on 20.5 off
47785	Mariana	Female	549	6116	6 on 20.5 off
52643	Bidibid	Male	538	6117	5.5 on 35 off
47689	Boris	Male	499	6118	5.5 on 35 off
47743	Nettie	Female	624	6119	5.5 on 35 off
47693	Poly	Female	594	6120	5.5 on 35 off
47788	Moana	Female	576	6121	5.5 on 35 off
47750	Louis	Male	5041	6122	5.5 on 35 off

days. Most of the birds will have been at sea when the release mechanism fired, and transmitters released over water sink so that no further signals can be received from them. Transmitters released on land are unlikely to transmit reliably from close to the ground amongst vegetation.

We believe that all ten release mechanisms fired at 54 days and most transmitters fell straight into the sea, but at least one fell to the ground near the bird's nest. The remaining two stayed on the birds for some time because the harness strings did not release cleanly. About 60 days after it had stopped transmitting, one transmitter that had fallen to the ground was disturbed (probably by an albatross chick on the nest) so that it was able to successfully transmit for a short while.

Sirtrack, who built the timed release mechanism accepted responsibility for the early release and supplied 10 replacement transmitters to deploy during the summer of 1998/99.

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Appendix 1

STUDY AREA NESTS, ANTIPODES I., FEB 1998

NEST	FEMALE		MALE		COMMENTS
	METAL	DARVIC	METAL	DARVIC	
	'R' BAND		'R' BAND		
4	47624	Blue-200	47630	Blue-049	
6	53804	Blue-348	53820	Blue-443	
9	53787	Blue-379	53808	Blue-426	
16	47741	Blue-102	47686	Blue-386	
17	53765	Blue-165	53767	Blue-258	
18	47748	Blue-401	47697	Blue-080	
19	52664	Blue-268	52622	Blue-077	
20	53778	Blue-297	53816	Blue-437	
24	52627	Blue-220	52656	Blue-094	
32	47658	Blue-378	47733	Blue-043	
37	47740	Blue-385	47684	Blue-101	
43	53766	Blue-197	53821	Blue-444	
48	48021	Blue-267	47924	Blue-352	
51	47760	Blue-246	47614	Blue-245	
57	53798	Blue-407	53805	Blue-417	
64	47638	Blue-310	47776	Blue-145	
65	47793	Blue-270	47690	Blue-087	
66	52653	Blue-448	28644	Blue-291	Outside study area
67	53818	Blue-440	53779	Blue-354	
69	47854	Blue-301	47961	Blue-122	
72	53809	Blue-430	53823	Blue-438	
73	47845	Blue-302	47957	Blue-125	
74	47932	Blue-328	47811	Blue-305	
76	52603	Blue-249	52663	Blue-170	
77	47979	Blue-213	47876	Blue-076	
86	47985	Blue-070	48011	Blue-265	
87	53802	Blue-346	53813	Blue-433	
89	47850	Blue-313	47959	Blue-223	
90	53829	Blue-424	53774	Blue-289	
91	52732	Blue-171	53631	Blue-002	Deserted when male returned but failed to take over from female
95	48060	Blue-337	48006	Blue-140	
102	47802	Blue-410	47707	Blue-208	
104	47612	Blue-336	47759	Blue-156	
106	52669	Blue-143	52609	Blue-307	
113	47994	Blue-048	47901	Blue-299	
132	47613	Blue-157	47722	Blue-255	
136	47726	Blue-053	47643	Blue-408	
137	47721	Blue-045	47629	Blue-242	
158	47926	Blue-207	48018	Blue-062	
160	52629	Blue-411	52668	Blue-082	
161	52614	Blue-392	28610	Blue-148	
166	47827	Blue-151	48026	Blue-247	
167	53760	Blue-058	53768	Blue-262	

NEST	FEMALE		MALE		COMMENTS
	METAL 'R' BAND	DARVIC	METAL 'R' BAND	DARVIC	
169	53796	Blue-405	53759	Blue-044	
178	47869	Blue-447	53832		
188	47700	Blue-332	47749	Blue-079	
482	52620	Blue-032	52619	Blue-033	
483	52741	Blue-034	52738	Blue-192	
484	47716	Blue-027	47805	Blue-257	
485	53803	Blue-347	53815	Blue-435	
487	47719	Blue-029	47626	Blue-185	
488	47767	Blue-375	47625	Blue-035	
490	53764	Blue-095	53769	Blue-271	
491	47675	Blue-231	47674	Blue-130	
492	47958	Blue-117	47848	Blue-115	
493	47839	Blue-132	48028	Blue-333	
495	52648	Blue-124	52633	Blue-123	
496	47671	Blue-338	47670	Blue-133	
497	52634	Blue-404	52672	Blue-128	
498	47791	Blue-107	47683	Blue-105	
499	47744	Blue-129	47689	Blue-372	
500	52670	Blue-030	52678	Blue-031	
501	28695		52677	Blue-450	Outside study area
502	47765	Blue-284	47620	Blue-182	
504	52604	Blue-026	52618	Blue-025	
505	47814	Blue-178	47936	Blue-020	
506	47728	Blue-194	47648	Blue-038	
507	47649	Blue-040	47804	Blue-195	
510	47890	Blue-391	47987	Blue-041	
511	52611	Blue-176	52647	Blue-012	
512	28954	Blue-013	47756	Blue-014	
513	52640	Blue-177	47606	Blue-010	
514	53624	Blue-317	53614	Blue-251	
515	47607	Blue-340	47713	Blue-007	
517	47668	Blue-234	28666	Blue-233	
518	47952	Blue-175	53772	Blue-285	
519	47604	Blue-343	47754	Blue-003	
520	53794	Blue-399	53761	Blue-059	
521	47685	Blue-402	47792	Blue-097	
522	47679	Blue-114	47789	Blue-226	
523	47682	Blue-112	47739	Blue-111	
525	47787	Blue-334	47676	Blue-127	
526	52652	Blue-067	52617	Blue-368	
527	53810	Blue-428	53770	Blue-274	
528	47919	Blue-287	48012	Blue-071	
529	52675	Blue-084	52624	Blue-292	
530	47692	Blue-218	47745	Blue-384	
531	52676	Blue-449	28771	Blue-221	Outside study area
532	52655	Blue-356	52630	Blue-222	
533	47803	Blue-327	47603	Blue-172	
534	53632	Blue-396	53603	Blue-183	
535	28746	Blue-364	28609	Blue-179	
536	47840	Blue-229	48029	Blue-228	
537	52651	Blue-261	52613	Blue-201	
538	47666	Blue-236	52643	Blue-311	

NEST	FEMALE		MALE		COMMENTS
	METAL 'R' BAND	DARVIC	METAL 'R' BAND	DARVIC	
539	48015	Blue-212	47920	Blue-211	
540	47963	Blue-269	53828	Blue-451	
542	47771	Blue-323	28624	Blue-240	
543	52638	Blue-329	52649	Blue-244	
544	53807	Blue-420	53822	Blue-445	
545	47657	Blue-288	47784	Blue-418	
546	47673	Blue-230	47737	Blue-131	
547	52607	Blue-152	52662	Blue-153	
548	47714	Blue-243	53789	Blue-390	
549	47785	Blue-321	47661	Blue-238	
550	48001	Blue-239	53792	Blue-395	
551	48068	Blue-397	47999	Blue-204	
552	28773	Blue-400	28664	Blue-214	
553	47715	Blue-250	47616	Blue-167	
554	52667	Blue-266	47753	Blue-209	Outside study area
555	52615	Blue-051	52666	Blue-206	
556	19227	Blue-210	53773	Blue-286	
557	47681	Blue-224	47790	Blue-273	
562					Already failed when found
563	53785	Blue-367	53790	Blue-393	
564	53824	Blue-446	47663	Blue-237	
566	47605	Blue-174	47712	Blue-173	
569	47768	Blue-187	47627	Blue-389	
570	47699	Blue-300	47796	Blue-371	
571	47773	Blue-282	47632	Blue-158	
572	47667	Blue-303	47786	Blue-322	
573	53776	Blue-295	53791	Blue-394	
574	53795	Blue-339	53800	Blue-413	
575	53784	Blue-366	53793	Blue-398	
576	47788	Blue-121	47678	Blue-120	
578	53797	Blue-406	53781	Blue-361	
579	47780	Blue-260	47644	Blue-259	
580	52606	Blue-047	52646	Blue-046	
581	53780	Blue-357	53788	Blue-387	
583	28634	Blue-272	47738	Blue-344	
585	47646	Blue-055	28620	Blue-054	
587	47836	Blue-277			Female deserted 16 days after laying
588	52671	Blue-355	52625	Blue-215	
589	52650	Blue-275	52635	Blue-312	
590	52623	Blue-383	52674	Blue-083	
591	47634	Blue-331	47774	Blue-319	
592	48010	Blue-382	48052	Blue-263	
593	52608	Blue-256	52637	Blue-162	
594	47693	Blue-217	47794	Blue-216	
595	53782	Blue-362	53819	Blue-442	
596	53783	Blue-363	53830	Blue-425	
597	47996	Blue-429	47904	Blue-193	
598	52641	Blue-253	52612	Blue-252	
599	53799	Blue-409	53827	Blue-422	
620	53831		53826	Blue-423	
621	53801	Blue-345	53833		

NEST	FEMALE		MALE		COMMENTS
	METAL 'R' BAND	DARVIC	METAL 'R' BAND	DARVIC	
622	47704	Blue-370	47798	Blue-353	
623	53814	Blue-434	53825	Blue-416	
624	47743	Blue-403	47688	Blue-225	
625	53786	Blue-374			Female deserted the egg within a day of laying
626			48056	Blue-376	
628					Already failed when found
629	48008	Blue-412	47911	Blue-380	
5041	47701	Blue-139	47750	Blue-358	
5048	47656	Blue-074	28717	Blue-073	
5051	47783	Blue-075	47655	Blue-205	
5057	53771	Blue-278	53777	Blue-296	
5081	47891	Blue-184	48044	Blue-298	
5084	53806	Blue-419	53817	Blue-439	
5086	52626	Blue-085	52654	Blue-414	
5087	52639	Blue-377			
5088	47775	Blue-315	47637	Blue-320	
5097	53762	Blue-092	53775	Blue-294	
5098	53811	Blue-432	53763	Blue-093	
5109	47834	Blue-144	48027	Blue-349	
5133	47734	Blue-316	47664	Blue-143	
5141	53812	Blue-436	47975	Blue-138	
5142	47694	Blue-235	47746	Blue-136	
5193	47874	Blue-142	47977	Blue-141	
5195	47736	Blue-232	47672	Blue-134	
5197	52661	Blue-164	52610	Blue-324	
5198	47703	Blue-421	47752	Blue-078	

Appendix 2

BIRDS BANDED BEFORE 1994 RECOVERED IN THE PERMANENTLY MARKED CENSUS AREA ON ANTIPODES I., 13–19 FEB 1998

BAND NO.	DATE	GRID REF.	STATUS	GIBSON PLUMAGE SCORE			
				HEAD	BACK	WING	TAIL
R28733	13 Feb 98	112-094	Female on egg	1.25	1.75	1	1
R28889	13 Feb 98	113-088	Female on egg	1.5	1.5	1	1
R35307	13 Feb 98	109-093	Male on egg	2	2	1	1
R28986	13 Feb 98	110-093	Female on egg	1.5	1.25	1	1
R29033	13 Feb 98	112-087	Female on egg	2	2	1	1
R28752	13 Feb 98	113-087	Male on egg	3.5	4	1.75	1.25
R28766	15 Feb 98	113-086	Male on egg	4	4	2	2
R35314	15 Feb 98	113-084	Male on egg	3.75	4	1.75	1.75
R29076	15 Feb 98	112-085	Female on egg	1.5	1.25	1	1
R35322	15 Feb 98	112-083	Male BOG*	3	3	1.5	1.5
R35309	15 Feb 98	114-084	Male on egg	4	3.75	2	1.25
R29018	15 Feb 98	113-085	Female on egg	2	2	1	1
R29016	15 Feb 98	112-086	Male on egg	4	4	2.5	2
R29008	15 Feb 98	112-087	Male on egg	4	4	2.5	1.5
R35647	15 Feb 98	112-085	Female on egg	2	1.25	1	1
R29030	18 Feb 98	109-084	Male on egg	2.75	3	2	1.75
R35653	18 Feb 98	114-081	Male BOG	2.5	4	2	1.75
R35630	18 Feb 98	110-084	Male BOG	3.5	3.75	2	1.75
R35257	18 Feb 98	109-083	Female on egg	1.75	1.75	1	1
R35276	18 Feb 98	106-082	Female on egg	1.75	1.5	1	1
R19421	18 Feb 98	111-083	Male BOG	4	4	2	1.5
R19416	18 Feb 98	110-081	Male BOG	4	3.75	2	1.5
R29038	18 Feb 98	110-081	Male on egg	3	3	2	1.25
R35666	18 Feb 98	110-080	Male on egg	4	2	2	1.25

*BOG = bird on ground.