GIANT PETREL *MACRONECTES* SPP. BAND RECOVERY ANALYSIS FROM THE INTERNATIONAL GIANT PETREL BANDING PROJECT, 1988/89

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SUMMARY

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During the 1988/89 breeding season, totals of 1759 Northern Giant Petrel *Macronectes halli* and 5852 Southern Giant Petrel *M. giganteus* chicks were banded as part of a concerted effort to determine dispersal patterns and pre-breeding movements throughout the range of both species. Movements of juvenile giant petrels were determined with band recoveries during subsequent years. Sparse recoveries prevented the fulfillment of all project objectives, however, we were able to highlight dispersal patterns which differed slightly from published accounts.

INTRODUCTION

The International Giant Petrel Banding Project was proposed in 1986 under the auspices of the Bird Biology Subcommittee of the Scientific Committee on Antarctic Research (SCAR-BBS), which suggested that a concerted effort be made to band Northern *Macronectes halli* and Southern *M. giganteus* Giant Petrel chicks from the 1988/89 cohort. As outlined in Hunter (1986, 1990), project objectives were to determine:

1. patterns of dispersal of fledglings from different geographical localities and interspecific differences in the speed and direction of dispersal;
2. wintering areas of juvenile birds;
3. incidence of inter-colony visitation by pre-breeding birds; and
4. recruitment of birds from other breeding sites into different populations.

This report reviews existing recoveries and summarizes the project's status to date, including recommendations for further work.

METHODS

Northern and Southern Giant Petrel chicks were banded at 11 localities during the 1988/89 summer (Table 1). Banding officers and representatives of Antarctic programmes were encouraged to report any band recoveries to the SCAR-BBS for analysis. Since we cannot quantify recovery effort, the analyses were dependent on those data made available to the authors, with inherent limitations such as the distribution of human populations along southern hemisphere continental land masses. Such limitations introduced unknown biases into the analyses presented here. All recoveries submitted were compiled and analyzed (Appendix 1). Recovery reports included location of recovery, distance covered and time elapsed between banding and recovery and condition of the giant petrel at the time of recovery. As detailed in Table 2, this analysis does not include complete information on subsequent recoveries from one national programme known to have participated in the banding effort (Brazil).

RESULTS

Totals of 1759 Northern and at least 5852 Southern Giant Petrel chicks were banded (Table 1); band recoveries are tabulated in Appendix 1, which shows that as of May 1998, 24 distant recoveries of Northern and Southern Giant Petrels had been reported. Two individuals were reported twice, one of which was found dead 11 days after the initial sighting. Of the 24 recoveries, five were Northern Giant Petrels; 19 Southern Giant Petrels. This represents a recovery rate of 0.29% and 0.32%, respectively (Tables 2a,b). Although recoveries were minimal, the relative percentages suggest little difference in recovery frequency between the two species. The average for both species (0.31%) is considerably lower than Hunter (1984) reported for giant petrels fledging from Bird Island, South Georgia (*c.* 3%) and by Woehler & Johnstone (1988) for Macquarie Island (2.39%). Weimerskirch *et al.* (1985) reported a recovery rate of 0.82% for both Northern and Southern Giant Petrels over 31 years of banding, a percentage slightly greater than this study.

Thirteen (54.2%) of the 24 recoveries occurred in Australia, a percentage similar (51%) to Hunter's (1984) analysis from South Georgia (Table 3). Of the three individuals recovered at sea (Table 3), two were located in Australian waters, bringing the cumulative percentage of giant petrels recovered in the Australian region to 62.5%. An additional seven (29.1%) recoveries were reported from New Zealand. No recoveries were reported from South America, and only one recovery occurred near South Africa (at sea). Mean distance travelled between banding and recovery sites was 7730 and 9725 km for Northern and Southern Giant Petrels, respectively. These distances were not significantly different between the two species (Student's *t*-test, $\alpha = 0.05$, $t = 1.12$, $P = 0.30$). However, it should be noted that these estimates are based on great-circle measures of distance, which most likely underestimate actual distance flown.

Direction of travel between banding and recovery locations was generally northward and eastward. Fledglings departing from their natal islands appeared to track the predominant

TABLE 1

Total number of giant petrel chicks banded at 10 localities for the 1988/89 cohort. Latitude and longitude are expressed in decimal format for consistency with tabled band recoveries (see Appendix 1)

Locality	Position	*M. halli*	*M. giganteus*
Marion Island	46.57°S, 37.75°E	168	1203
Macquarie Island	54.50°S, 58.95°E	563	761
Iles Crozet	46.42°S, 51.83°E	12	6
Terre Adélie, Antarctica	66.67°S, 140.02°E	0	8
Anvers Island	64.77°S, 64.07°W	0	312
King George Island:			
Admiralty Bay	62.17°S, 58.48°W	0	93
Maxwell Bay	62.25°S, 58.85°W	0	1
Elephant Island	61.13°S, 55.12°W	0	2000[1,2]
and Penguin Island	62.10°S, 57.90°W	0	[1,2]
Signy Island	60.70°S, 45.00°W	0	999
Bird Island, South Georgia	54.02°S, 38.05°W	1016	469
Totals		**1759**	**≥5852**

[1] Grand total only available for giant petrels banded on Elephant and Penguin Islands combined.
[2] Recovery data (Brazil) not available.

TABLE 2

Band recovery summary by banding programme of origin for A. Northern and B. Southern Giant Petrels, 1988/89 cohort

A. Northern Giant Petrel

Country	Localities	No. banded	No. recovered	% recovered
Australia	Macquarie Island	563	2	0.36
France	Iles Crozet	12	0	0
South Africa	Marion Island	168	1	0.60
United Kingdom	Bird Island, Signy Island	1016	2	0.20
Totals and overall %		**1759**	**5**	**0.29%**

B. Southern Giant Petrel

Country	Localities	No. banded	No. recovered	% recovered
Australia	Macquarie Island	761	3	0.39
Brazil	Elephant and Penguin Islands	2000	4[1]	0.20
Germany	Maxwell Bay, King George Island	1	0	0
France	Iles Crozet, Terre Adélie	14	0	0
South Africa	Marion Island	1203	2	0.17
United Kingdom	Bird Island, Signy Island	1468	9	0.61
United States	Admiralty Bay, King George Island,	93	0	0.0
	Palmer Station, Anvers Island	312	1	0.32
Totals and overall %		**5852**	**19**	**0.32%**

[1] Recovery information provided by the Australian Bird and Bat Banding Scheme (ABBBS). More recoveries may exist, however, no information has been submitted to SCAR-BBS by Brazil.

westerly winds and were most often recovered in Australia and New Zealand (Table 3). Unlike other accounts (Hunter 1984, Woehler & Johnstone 1988, Voisin 1990), there was no eastward progression of recoveries with time during the first 12 months after fledging. For example, the earliest recoveries involved fledglings that travelled 7913 km in 60 days (Northern Giant Petrel) and 9962 km in 60 days (Southern Giant Petrel). These originated on Marion and Signy Islands, respectively, and were subsequently recovered in Australia and New Zealand. In contrast, some later recoveries involving shorter flight distances (e.g. between Macquarie Island and New Zealand, *c*. 1250 km) lasted 82 days, or three weeks longer than the early recoveries and covered only one sixth of the distance. Although fledglings may have flown directly from Macquarie Island to New Zealand (north-west, or against the prevailing easterly winds), the length of time between fledging and recovery suggests that a more circuitous route was flown.

The condition of recovered individuals is summarized in Table 4. Of the 24 recoveries, 15 (62.5%) were found dead and six (25.0%) were released alive. An additional two birds (8.3%) were recovered in conjunction with fishing activities; one died (Northern Giant Petrel) and the other, a Southern Giant Petrel, was released alive after accidental capture by the Australian shark fishery. A comparison of mortality rates between the two species of giant petrels is not possible given the paucity of recoveries.

All Northern Giant Petrels were recovered within the same calendar year banded (Tables 5a,b). Of the 19 Southern Giant Petrels recovered, 14 were recovered within the first calendar year (73.6%), three during year two (15.8%) and one each during years three and four (5.3% each). The mean number of days between banding and recovery for Northern Giant Petrels (115) and Southern Giant Petrels (292) was significantly different (Student's *t*-test, $\alpha = 0.05$, $t = 2.23$, $P = 0.036$). The median months of recovery also varied by species: April for Northern Giant Petrels and July for Southern Giant Petrels. This difference most likely reflects the six-week difference in fledging dates between the two species. Northern Giant Petrels fledge in March whereas Southern Giant Petrels fledge in May (Hunter 1984).

TABLE 3

Summary of localities where recoveries of Northern and Southern Giant Petrels have been reported. Percent of total represents recoveries for both species

Location	NGPE[a]	SGPE[b]	Total	% of total
Australia	1	12	13	54.2
New Zealand	2	5	7	29.2
Pacific Region	1	0	1	4.2
South Africa	0	0	0	0
South America	0	0	0	0
Recovered at sea[c]	1	2	3	12.5
Totals	**5**	**19**	**24**	

[a] Northern Giant Petrels. [b] Southern Giant Petrels.
[c] Includes one individual of each species caught in fisheries-related activities. Of the three, two were recovered near Australia (one fisheries-related catch) and one near South Africa (fisheries-related).

TABLE 4

Condition of individual giant petrels recovered

Recovery condition	NGPE[a]	SGPE[b]	Total	% of recoveries
Released alive (exhausted)	0	6	6	25.0
Dead (found dead or exhaustion-related death)	4	11	15	62.5
Fisheries related catch, dead	1	0	1	4.2
Fisheries related catch, released alive	0	1	1	4.2
Unknown	0	1	1	4.2
Totals	**5**	**19**	**24**	

[a] Northern Giant Petrels. [b] Southern Giant Petrels.

TABLE 5

Months of recovery for Northern Giant Petrel and Southern Giant Petrel. Bold indicates median recovery month for each species. Recovery percentages are given by year. There were no recoveries beyond calendar year 1 (1989) for Northern Giant Petrels. For Southern Giant Petrel recoveries, years 1–4 correspond to calendar years 1989–1992, respectively

A. Northern Giant Petrel

	Jan	Feb	Mar	**Apr**	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% recoveries
Year 1			1	2	1						1		5	100
Year 2													0	0

B. Southern Giant Petrel

	Jan	Feb	Mar	Apr	May	Jun	**Jul**	Aug	Sep	Oct	Nov	Dec	Total	% recoveries
Year 1				1	1	3	5	2			1	1	14	73.7
Year 2	1					1				1			3	15.8
Year 3						1							1	5.3
Year 4						1							1	5.3

DISCUSSION

Distant recovery rates for Northern and Southern Giant Petrels of the 1988/89 cohort were considerably lower (0.31%) than previous estimates based on other cohorts (Ingham 1959, Tickell & Scotland 1961, Sladen *et al.*1968, Hunter 1984, Weimerskirch *et al.* 1985, Woehler & Johnstone 1988). Tickell & Scotland (1961) and Hunter (1984) have suggested that high inter-annual variability in recovery rates may be closely related to wind patterns and storm intensity. Weather conditions after fledging of the 1988/89 cohort may thus have contributed to the lower recovery rates compared with cohorts from past studies. Furthermore, limitations on recovery effort and reporting may have artificially decreased the calculated recovery rate.

Over 90% of the recoveries were from Australia and New Zealand (including two at sea). This is considerably higher than Hunter's (1984) estimate of 50% and Parmelee & Parmelee's (1987) reported 75%. Voisin (1990) has hypothesized that concentrations of young giant petrels in these regions are in part due to a funnelling effect by landmasses and weather patterns. Woehler & Johnstone (1988) suggest that the arrangement of Southern Hemisphere land masses in relation to breeding localities also bias the distribution of recoveries towards these regions. Heightened observer interest in these areas in addition to their populated coastal zones and abundant marine resources may also contribute to consistently high recovery rates from these areas (Johnstone 1977, Weimerskirch *et al.* 1985). Relatively few recoveries were reported near South Africa (one recovery, fisheries related) or South America which contrasted with previous studies (Stonehouse 1958, Sladen *et al.* 1968, Hunter 1984, Parmelee & Parmelee 1987, Woehler & Johnstone 1988). Dispersal patterns revealed an eastward movement of fledglings from banding sites, a pattern that Hunter 1984, Gartshore *et al.* 1988, Woehler & Johnstone 1988 and Voisin 1990 attribute partly to predominant wind direction.

Nearly 80% of the recoveries occurred within the first calendar year after banding for both species. All five Northern Giant Petrel recoveries occurred between late March and early November 1989, whereas fourteen (73.6%) of the Southern Giant Petrel recoveries occurred between April and December 1989. Three additional Southern Giant Petrel yearlings were seen during 1990 (Year 2), and one each during 1991 and 1992 (Years 3 and 4). It is not uncommon for most recoveries to occur during the first year after banding, as most juveniles can be found inshore, either exhausted by storms, attracted by concentrated food resources or within groups of congeneric individuals (Hunter 1984, Weimerskirch *et al.* 1985, Parmelee & Parmelee 1987, Voisin 1990). After their first year, juvenile giant petrels become more oceanic and band recoveries between year two and breeding are uncommon (Stonehouse 1958, Tickell & Scotland 1961, Hunter 1984). Furthermore, Hunter (1984) concluded that it is difficult to know how long individuals remain at any inshore locality before becoming more oceanic in distribution. As suggested by Voisin (1990), there is no evidence of long-term wintering areas. However, the high percentage of band recoveries from Australian and New Zealand waters suggest that juvenile giant petrels may concentrate in this region during winter.

The range between banding and recovery date spanned 197 days for Northern Giant Petrels and 1172 days for Southern Giant Petrels. The average number of days that elapsed between banding and recovery was significantly shorter for Northern Giant Petrels because all recoveries occurred during the first calendar year. For example, even the longest flight by a Northern Giant Petrel (11 517 km, Bird Island to New Zealand, Appendix 1) was completed in 257 days. Downes *et al.* (1954), Stonehouse (1958) and Gartshore *et al.* (1988) reported similar long-distance migrations undertaken by pre-breeding giant petrels. Southern Giant Petrels, in contrast, displayed much more variability in the number of days before recovery (60–1232 days). Although Hunter (1984) found that most recoveries after three years involved birds returning to their natal sites (South Georgia), this study obtained only one recovery three years after banding, a Southern Giant Petrel recovered in 1992 in Australian waters 12 500 km from the banding site on Signy Island. Although recovery distances are expressed as great circle distances, the length of time elapsed between fledging and recovery suggests that much greater travel distances were actually covered by fledglings. Direct distance comparisons with other research should be viewed with caution because of limited band recovery sample sizes and insufficient observation effort in some locations. A better representation of dispersal patterns may require several seasons of banding and recovery data to develop long-term dispersal and survival trends as illustrated by other studies (Ingham 1959, Tickell & Scotland 1961, Hunter 1984, Weimerskirch *et al.* 1985, Parmelee & Parmelee 1987, Gartshore *et al.* 1988, Woehler & Johnstone 1988, Trivelpiece & Trivelpiece 1998).

Two recoveries (8.3%) were involved in fisheries-related incidents. Hunter (1984) reported an estimated 9% of recoveries from the South Georgia study population were caught by fishing lines or net entanglement. Jouventin & Weimerskirch (1990) partly attribute decreases in procellariiform populations to fishing operations, as well as deliberate shooting at sea. However, fisheries-related mortality may be critically underestimated for two reasons. Woehler (1996) has suggested that non-breeders buffer the obvious population declines by filling vacancies in the breeding population, thus slowing the otherwise obvious decrease in breeding population size. Secondly, the time lag due to delayed breeding age will offset cohort-specific trends by approximately six years in giant petrels (Woehler 1996). Furness & Ainley (1984) further identify threats to seabirds with specialized feeding behaviour, such as surface-feeding Southern Giant Petrels. Extensive pelagic foraging by this species may thus have magnified its susceptibility to interactions with commercial fisheries. This might in part explain the decreases in Southern Giant Petrel populations in contrast to increasing populations of Northern Giant Petrels, which are more prone to scavenge on or near land areas (Patterson *et al.* in press).

CONCLUSIONS AND RECOMMENDATIONS

The International Giant Petrel Banding Project was undertaken during the 1988/89 season with the objectives of determining pre-breeding movements of both Northern and Southern Giant Petrels, interspecific differences in dispersal, wintering areas of juvenile birds, and recruitment of individuals at non-natal breeding sites. Unfortunately, meeting a portion of these objectives will require further inquiry due to insufficient data. In the 10 years following the banding effort, only 24 recoveries and recaptures were reported to the SCAR Bird Biology Subcommittee for both species combined. Two Antarctic programmes have neither submitted banding totals nor band recoveries, and no programmes have reported observations on breeding adults originating with the 1988/89 cohort. This paucity of data does not permit a rigorous statistical analysis of recoveries, hence few definitive conclusions can be drawn. For example, we cannot determine the wintering areas of juvenile birds, the incidence of inter-colony visiting by pre-breeding birds, or the recruitment of birds from other breeding sites into different populations. Considering the oceanic nature of pre-breeding giant petrels and the difficulty of obtaining band recoveries, these questions are thus likely to remain unanswered using only banding techniques.

The limited analyses that were possible have shown results mostly similar to previous banding and recovery studies with some minor differences discovered despite small sample sizes. Giant petrel fledglings generally moved in an easterly direction within a broad range of Southern Hemisphere latitudes. Most recoveries occurred in Australia and New Zealand and nearly 80% of recoveries occurred within the first calendar year (1989) after banding. Recoveries from the 1988/89 cohort differed from published studies in that only one recovery was reported near South Africa and no recoveries were reported from South America. A clear temporal eastward progression was not as apparent as with previous studies (Woehler & Johnstone 1988), again, limited search effort may confound this conclusion. Average percent of fledglings recovered (0.31%) was considerably lower than previous studies, perhaps, as other authors have suggested, because weather conditions and storm intensity may negatively impact the range and extent of fledgling movements. Furthermore, previous recovery analyses typically include several seasons of recovery and survival data that may be more representative of giant petrel dispersal after fledging.

All participants are encouraged to search for breeding adults from the 1988/89 cohort in the future. With this information, recruitment into non-natal populations can be examined, thereby fulfilling the fourth aim of this project. In addition, members of the Brazilian Antarctic Programme are encouraged to review and report complete recovery records, as this effort may add valuable data. Finally, we recommend that data based on deployment of satellite transmitters be considered in future giant petrel research to address some of the objectives of this project that remain unresolved due to insufficient or difficult to collect data.

The International Giant Petrel Banding Project was relatively successful in achieving international cooperation within a large-scale banding programme. Whereas all the optimal objectives of this project were not achieved, the project was nonetheless able to compile and summarize valuable recovery data on the dispersal and movements of juvenile Northern and Southern Giant Petrels.

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APPENDIX 1

Band recovery data for Northern and Southern Giant Petrels, 1988/89 cohort. Time elapsed is given in days. Latitude and longitude are expressed in GPS decimal format. Distance is reported in kilometres as a great-circle measure between banding and recovery locations

Northern Giant Petrel

Origin	Band number	Banding location	Banding date	Recovery date	Time elapsed	Recovery location	Latitude	Longitude	Distance	Condition	Comments
Australia	131-55919	Macquarie Island	14/1/89	20/4/89	96	New Zealand	40.68°S	175.15°E	1950	Beachwashed/dead	
Australia	131-58989	Macquarie Island	16/1/89	15/4/89	89	Sea	34.25°S	22.14°E	9273	Fishing/dead	Estimated recovery date
South Africa	948193	Marion Island	21/1/89	22/3/89	60	Australia	40.00°S	144.00°E	7913	Dead, cause unknown	
U.K.	1230076	Bird Island	21/2/89	9/5/89	77	New Zealand	36.92°S	174.50°E	11 517	Found dead	
U.K.	1220149	Bird Island	20/2/89	4/11/89	257	Pitcairn Island	24.67°S	124.80°W	7959	Found dead	

Southern Giant Petrel

Origin	Band number	Banding location	Banding date	Recovery date	Time elapsed	Recovery location	Latitude	Longitude	Distance	Condition	Comments
Australia	131-55958 [a]	Macquarie Island	9/2/89	10/10/90	609	Australia	31.02°S	115.33°E	4307	Exhausted/reeasedl alive	
Australia	131-58625	Macquarie Island	8/2/89	13/8/89	186	Australia	32.67°S	134.17°E	3101	Beachwashed/dead	
Australia	131-58643[b]	Macquarie Island	8/2/89	11/5/89	92	New Zealand	45.10°S	170.97°E	1352	Found dead	Second recovery
Brazil	BVO-8159	Elephant Island	20/2/89	20/1/90	334	Australia	34.28°S	117.50°E	9361	Beachwashed/dead	
Brazil	BVO-8425	Elephant Island	22/2/89	22/7/89	150	Australia	28.00°S	153.46°E	9745	Released alive	
Brazil	BVO-8901	Elephant Island	23/2/89	4/7/89	131	Australia	34.46°S	135.33°E	9317	Released alive	
Brazil	BVO-9058	Penguin Island	6/3/89	2/8/89	149	Australia	23.90°S	152.38°E	10 089	Released alive	
South Africa	948389	Marion Island	25/1/89	4/7/89	160	Australia	33.34°S	151.55°E	8912	Released alive	
South Africa	948514	Marion Island	26/1/89	8/6/90	498	New Zealand	36.40°S	174.07°E	9787	Exhausted/died	
U.K.	1230444	Bird Island	22/2/89	1/7/91	859	Sea	45.00°S	141.00°E	12 907	On ship/dead	300 miles off Tasmania
U.K.	5155090	Signy Island	22/2/89	11/6/89	109	Australia	37.85°S	148.07°E	12 021	Exhausted/dying[c]	
U.K.	5155136	Signy Island	23/2/89	24/4/89	60	New Zealand	43.78°S	172.79°E	9662	Found dead	
U.K.	5155343	Signy Island	6/3/89	2/7/89	118	Australia	32.50°S	115.50°E	12 290	Found dead/storm	
U.K.	5155407	Signy Island	22/2/89	5/6/89	103	Australia	29.67°S	114.95°E	12 571	Exhausted/released alive	
U.K.	5155409	Signy Island	22/2/89	8/7/92	1232	Sea	38.00°S	140.80°E	12 507	Fishing/released alive	Trapped with shark bait
U.K.	5156637	Signy Island	6/3/89	7/11/89	246	New Zealand	45.78°S	170.73°E	8375	Found dead	
U.K.	5156645	Signy Island	6/3/89	9/6/89	95	Australia	35.47°S	138.33°E	12 995	Found dead	
U.K.	5156654	Signy Island	6/3/89	5/7/89	121	Australia	35.73°S	137.93°E	12 989	Found dead	
U.S.	648-05893	Anvers Island	14/2/89	12/12/89	301	New Zealand	42.33°S	173.67°E	12 500	Unknown	Estimated distance

[a] Individual reported twice (1 day apart), found dead on second reporting. Both recoveries were from the same locality in Western Australia.

[b] Individual reported twice (10 days apart), found dead on second reporting. First recovery was on the Otago Peninsula, New Zealand, 1 May 1989. Distance travelled between recoveries was approximately 83 km.

[c] Assumed to have died.