POST-FLEDGING DISPERSAL OF SOUTHERN GIANT PETRELS *MACRONECTES GIGANTEUS* BANDED AT ADMIRALTY BAY, KING GEORGE ISLAND, ANTARCTICA

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SUMMARY

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Banding returns of Southern Giant Petrels *Macronectes giganteus* from this and other studies indicate that, upon fledging, young birds disperse from their natal colonies in an easterly direction and travel great distances, often circumnavigating the Southern Ocean several times before returning to their natal colonies. This paper reports sightings and recaptures of fledglings during their first year of independence. We have no reports of recoveries of older juveniles prior to their returns to our breeding colony. Annual recovery rates of the 1575 chicks banded at Admiralty Bay, King George Island, from 1980–1996, are low (mean 0.8%, range 0–2.3%), but consistent with re-sightings reported from other studies in the Antarctic Peninsula region. Although the inter-colony distances between four major banding sites in the Antarctic Peninsula region exceed 1000 km and the site at Iles Crozet is well to the east of these in the Indian Ocean sector of the Southern Ocean, there are similarities among the returns across the sites. Sixty-eight percent of all band returns are from Australia (range 53–79%) and 50% of all recaptures are during July, two to three months post-fledging. Recaptures from New Zealand accounted for an additional 18% of all returns, with South America and southern Africa reporting returns from some, but not all, banding sites. Possible reasons for this include: Australia and New Zealand are the first major land masses the young birds encounter on their easterly journeys, search effort is greater in these countries than in the others, and banded birds caught in fishing nets are more likely to be reported.

INTRODUCTION

Southern Giant Petrels *Macronectes giganteus* have a circumpolar distribution, with breeding colonies from the sub-Antarctic islands south to the Antarctic Continent (Watson 1975, Johnstone 1977, Harrison 1983, Hunter 1985, Parmelee 1992). They are mainly scavengers, feeding on penguin and seal carcasses, but will also prey on penguins, other birds, crustaceans (krill and amphipods), squid, and fish (Johnstone 1977, Hunter 1983, 1985, Voisin 1990). Many of their breeding colonies are in the vicinity of penguin colonies, since this food resource, both living and dead, is often heavily exploited during chick rearing. Banding returns suggest that the first two to three years after fledging are spent at sea, circumnavigating the Southern Ocean (Sladen 1965, Harrison 1983, Hunter 1984a). The remaining pre-breeding years are probably spent in or around the natal colonies. Age at first breeding is as early as four years (Parmelee 1992), but normally first attempts to reproduce occur between six and ten years of age (Hunter 1984b, Parmelee 1992).

Banding of giant petrels began in 1948 (Sladen & Tickell 1958) and has since been conducted at several major sites including: Bird Island, South Georgia; Signy Island, South Orkneys; Anvers Island, Antarctic Peninsula; King George Island, South Shetlands; Prince Edward Islands and Gough Island in the South African Antarctic area, Iles Crozet and Isle Kerguelen in the Indian Ocean area and Heard and Macquarie Islands in the Australian Antarctic area (Fig. 1). Southern and Northern *M. halli* Giant Petrels were considered one species prior to 1966 and were not distinguished by banders (Bourne & Warham 1966). Thus, earlier return data are of limited use because later banding data from sites where they breed sympatrically suggest the two species have different recovery rates and wintering areas (Hunter 1984a).

We have been banding Southern Giant Petrel chicks at Admiralty Bay, King George Island, South Shetland Islands (62°10'S, 58°30'W) since 1980. Here we report the dates and locations of re-sightings of our banded first-year birds, compare them to the returns from other studies, examine trends in recovery rates over the last 40+ years and discuss their possible significance to the Southern Giant Petrel population as a whole. These data contribute to the international giant petrel dispersal study of the Bird Biology Subcommittee of the Scientific Committee on Antarctic Research. In addition, due to concerns over longline fisheries' incidental mortality of giant petrels, as broached recently by the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), these data will be helpful in determining just how serious this may be.

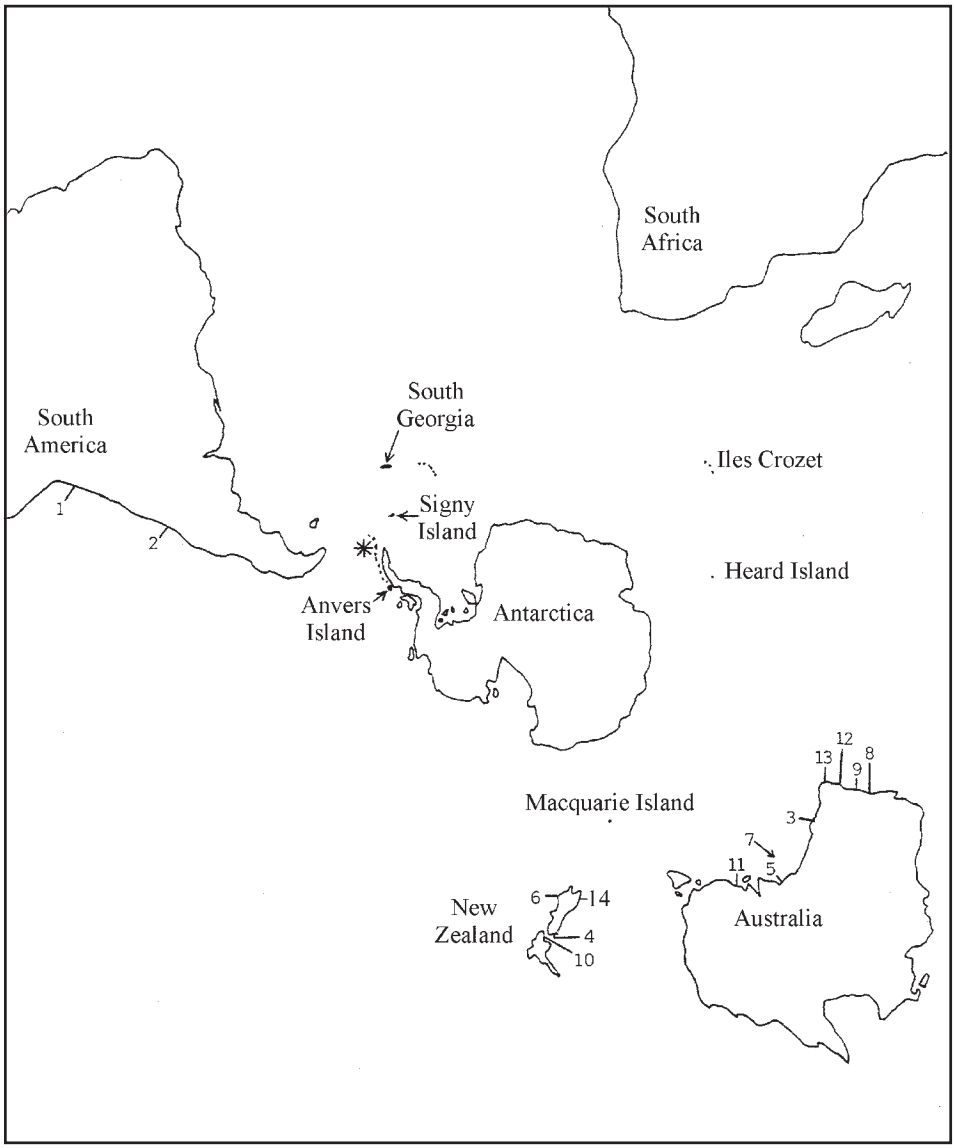

Fig. 1. *Recovery locations of Southern Giant Petrel fledglings banded at Admiralty Bay, King George Island, Antarctica.* ******* *indicates banding site (KGI); Numbers (1–14) indicate recovery locations, corresponding to the numbers in Table 2.*

METHODS

The western shore of Admiralty Bay, King George Island, supports five penguin colonies (two mixed Adélie *Pygoscelis adeliae*, Gentoo *P. papua*, and Chinstrap *P. antarctica* Penguin colonies, and three Chinstrap Penguin colonies) and several species of flying birds associated with them, including a Southern Giant Petrel population of about 150 pairs. There are also five species of seals that occur in the area: Southern Elephant *Mirounga leonina*, Weddell *Leptonychotes wedelli*, Crabeater *Lobodon carcinophagus*, Leopard *Hydrurga leptonyx*, and Antarctic Fur *Arctocephalus gazella*. The Southern Elephant and Weddell Seals are the only two that regularly breed in the area.

We have been banding all of the Southern Giant Petrel chicks at this site since the 1980/81 summer season. The numbers of chicks banded have varied, from 68 to 145 per year, depending on variations in the population size and reproductive success each season. Chicks are banded on the right leg using Number 8, butt-end, U.S. Fish and Wildlife Service bands, of both stainless steel and aluminium. The chicks are banded as late in the season as our schedule permits, usually in late February. Chicks hatch in early January, and there is minimal mortality after six weeks of age (Hunter 1984b); therefore, we have an accurate estimate of annual breeding success and of the numbers of chicks that fledge each season. The chicks fledge in early May and leave their natal areas; however, adults are observed at breeding sites throughout the winter months (Hunter 1984b, Parmelee 1992, Polish Antarctic Expedition members pers. comm.).

RESULTS

We have banded 1432 Southern Giant Petrel chicks at our site since the 1980/81 summer season, 13 (0.8%) of which have been re-sighted elsewhere (Table 1). Our recovery rates have varied from year to year, with some years producing no returns, results similar to those reported from other banding localities (Hunter 1984a, Voisin 1990, Parmelee 1992). All studies indicate that the number of returns each year is not proportional to the number of birds banded. We have also found considerable variations between years, both in overall

recovery rates and in recovery rates among birds banded at different sites (Tickell & Scotland 1961, Sladen 1965, Hunter 1984a). However, the recovery rates are too low to permit statistical analyses of the data.

All of our recoveries were of first-year birds, from as early as two months to a maximum of seven months post-fledging (Table 2). Hunter (1984a), Voisin (1990), Parmelee (1992), and T.B. Oatley (pers. comm.) recovered some older juveniles (two to three-year old birds); however, for comparisons with our results, only data from their first-year returns have been used. Our fledglings were recovered from Australia, New Zealand, and Chile (Table 2, Fig. 1), with the majority being from Australia (62%), followed by New Zealand (23%) and Chile (15%). Sladen & Tickell (1958), Hunter (1984a), Voisin (1990), T.B. Oatley (pers. comm.), and Parmelee (1992), had similar results, with most of their first-year Southern Giant Petrel recoveries coming from Australia (69%, 69%, 75%, 53% & 74%, respectively), followed by New Zealand, South America and/or Africa (Table 3).

The majority of our recoveries occurred in July (39%), followed by June, August, and October, with 15% each. The only other months with returns were September and December, with one recovery each (Table 4). Sladen & Tickell (1958), Hunter (1984a), and Parmelee (1992) reported similar trends, with 54%, 58%, and 53%, respectively, of their first-year returns occurring in July. The other winter months of June and August accounted for 25–33% of all additional recoveries reported by these authors. The few remaining returns were fairly evenly spread over later months (Table 4). T.B. Oatley (pers. comm.) also reported a high percentage of returns for June & July (24% & 29%, respectively); however, unlike this and all the other studies, there were also several returns in May (29%).

Most of our recovered birds were found dead (64%), and often emaciated, presumably having starved to death, results similar to those reported by Hunter (1984a) and Voisin (1990; Table 5). However, the majority of all recaptures reported by Sladen & Tickell (1958), were caught and released (50%). The remaining recoveries were either caught in fishing gear (which includes nets, lines, hooks, etc., with no indication of percentage of each) or had no other recovery details (Table 5).

TABLE 1

First-year Southern Giant Petrel recoveries by year

Year	No. banded	No. recovered	%
1980/81	68	0	0.0
1981/82	85	0	0.0
1982/83	100	1	1.0
1983/84	62	0	0.0
1984/85	90	2	2.2
1985/86	94	1	1.1
1986/87	96	0	0.0
1987/88	91	1	1.1
1988/89	93	0	0.0
1989/90	77	1	1.3
1990/91	85	1	1.2
1991/92	109	2	1.8
1992/93	106	0	0.0
1993/94	131	3	2.3
1994/95	145	1	0.7
1995/96	143	0	0.0
1996/97	105	1	0.9
Total	**1680**	**14**	**0.8**

DISCUSSION

Banding returns suggest that juvenile Southern Giant Petrels undertake a circumpolar migration after fledging, dispersing to the north and east, following the prevailing westerly winds (Tickell & Scotland 1961, Sladen 1965, Sladen *et al.* 1968, Johnstone 1977, Hunter 1984a, Parmelee 1992, this study). Young birds arrive in Australian waters one to three months after fledging, having just completed a long flight over open ocean. However, these juveniles are assumed to be relatively inexperienced foragers and have probably exhausted their energy reserves en route. Australia is the first major landfall to the east (i.e. downwind) for young birds banded at sites from the Antarctic Peninsula region to Iles Crozet (Fig. 1). Understandably, this is also where the majority (68%) of all

TABLE 2

Known-age Southern Giant Petrel band recoveries from Admiralty Bay, King George Island

Recov. no.	Band no.	Recovery location	Position	Recovery date	Band date	Age (yr) at recovery
1.	618–06370	Iquique, Chile	20°10'S, 70°00'W	26 Sep 1983	15 Feb 1983	<1
2.	728–45665	Laraquete, Chile	37°10'S, 73°10'W	06 Oct 1985	06 Feb 1985	<1
3.	728–45650	Swansea Heads, Australia	33°00'S, 121°40'E	10 Aug 1985	06 Feb 1985	<1
4.	728–45725	Makara Beach, New Zealand	41°10'S, 174°40'E	19 Oct 1986	08 Feb 1986	<1
5.	628–03745	Sceale Bay, Australia	33°00'S, 134°10'E	29 Jun 1988	10 Feb 1988	<1
6.	628–03750	Otago Peninsula, New Zealand	45°40'S, 170°40'E	15 Dec 1990	14 Feb 1990	<1
7.	648–03994	Aus. Bight, Australia	34°00'S, 133°30'E	06 Jun 1991	20 Feb 1991	<1
8.	818–06295	Geraldton, Australia	27°40'S, 113°20'E	17 Jul 1992	15 Feb 1992	<1
9.	818–06289	Dongara, Australia	29°10'S, 114°50'E	01 Jul 1992	15 Feb 1992	<1
10.	818–06454	Himatanci Beach, New Zealand	40°20'S, 175°10'E	09 Jul 1994	25 Feb 1994	<1
11.	818–06529	Port Adelaide, Australia	34°50'S, 138°20'E	21 Jul 1994	26 Feb 1994	<1
12.	818–06536	Lancelin, Australia	31°00'S, 115°10'E	08 Aug 1994	26 Feb 1994	<1
13.	818–06549	Singleton Beach, Australia	32°20'S, 115°40'E	10 Jul 1995	20 Feb 1995	<1
14.	848–48304	South Island, New Zealand	44°50'S, 167°10'E	28 Sep 1997	06 Mar 1997	<1

TABLE 3

Recoveries of first-year Southern Giant Petrels by locality

	Australia		New Zealand		S. America		Africa		Other*		Total
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	
This study (King George Island)	8	(57)	4	(29)	2	(14)	0	0	14		
Sladen & Tickell (1958)(Total)	29	(69)	4	(10)	2	(5)	7	(17)	0	42	
[(Signey Island)	25	(74)	3	(9)	1	(3)	5	(15)	0	34]	
[(Anvers Island)	4	(50)	1	(12.5)	1	(12.5)	2	(25)	0	8]	
Hunter (1984a) (South Georgia)	24	(69)	10	(28)	0	1	(3)	0	35		
Voisin (1990) (Isles Crozets)	3	(75)	1	(25)	0	0	0	4			
T.B. Oatley (pers. comm.) (Marion Island)	9	(53)	4	(24)	2	(12)	0	2	(12)	17	
Parmelee (1992) (Anvers Island)	15	(79)	2	(11)	1	(5)	1	(5)	0	19	
Total	**88**	**(67)**	**25**	**(19)**	**7**	**(5)**	**9**	**(7)**	**2**	**(2)**	**131**

*Other locations include: Fiji, Indian Ocean

TABLE 4

Number (%) of first-year Southern Giant Petrel recoveries by month

Recovery month	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Total
This study	0	2 (14)	5 (36)	2 (14)	2 (14)	2 (14)	0	1 (7)	0	14
Sladen & Tickell (1958)	0	6 (21)	15 (54)	3 (11)	0	1 (4)	2 (7)	1 (4)	0	28
Hunter (1984a)	0	1 (3)	21 (58)	8 (22)	1 (3)	2 (5)	1 (3)	1 (3)	1 (3)	36
Parmelee (1992)	0	2 (11)	10 (53)	3 (16)	1 (5)	1 (5)	1 (5)	1 (5)	0	19
T.B. Oatley (pers. comm.)	5 (29)	4 (24)	5 (29)	1 (6)	0	0	0	2 (12)	0	17
Total	**5 (4)**	**15 (13)**	**56 (49)**	**17 (15)**	**4 (4)**	**6 (5)**	**4 (4)**	**6 (5)**	**1 (1)**	**114**

TABLE 5

Condition of recovered Southern Giant Petrels

Number (%)	Dead	Caught & released	Caught in fishing gear*	Caught & ? (no info.)	Total
This study	11(69)**	3(19)**	1(6)	1(6)	162
Sladen & Tickell (1958)	11(39)	14(50)	0	3(5)	28
Hunter (1984a)	16(76)***	4(19)	1(5)	0	21
Voisin (1990)	3(75)	0	0	1(25)	4
Total	**41(59)**	**21(30)**	**2(3)**	**5(7)**	**69**

* Fishing gear includes lines, hooks, nets, etc.

** One bird caught and released found dead eight days later (treated as two individuals).

*** Includes birds found dead (no specifics given) and dead on the beach after storms.

recoveries occurs (Table 3). This infers that the location of the natal colony appears to have little influence on where the fledglings go when they disperse.

Hunter (1984a) reports that during the winter months (June-August) juveniles, distinguished by their darker plumage (Harrison 1983), are found in large numbers close to shore, and he further suggests that they probably survive by scavenging on refuse and fish offal until they are strong enough to continue their circumpolar migration. These inshore, winter congregations make it easier for banded birds to be observed, captured, or, if they die, more likely to be washed ashore on beaches where they are sighted. Parmelee (1992) also suggested that Australia has a greater search effort for birds than other places on the Southern Giant Petrel's route, hence the higher number of recoveries from there. The combination of all these factors probably explains the greater amount of returns from Australia, compared to other sites.

Inter-annual variability in recovery rates is large for all sites. Hunter (1984a) suggests that differences in the frequency and severity of storms between years are a likely factor contributing to this variability each season. In addition, young birds, already exhausted from their long open-ocean migration during the food-limited winter period, may be especially prone to the additional stress of severe weather. Sibson (1969) reported that weak and starving giant petrels (both species) were forced ashore in New Zealand during heavy storms. Hunter (1984a) suggests that the high recovery rate among chicks banded in 1972/73 (6.1%), relative to other years, may reflect harsher winter weather conditions in that year. There are few recoveries after the winter period, as the birds are then more adept at foraging at sea, and are more dispersed and pelagic (Hunter 1984a).

Later recoveries typically come from areas farther to the east (e.g. New Zealand and South America), the latter being birds assumed to have made a complete circumnavigation. The reason there are no band recoveries from southern Africa for our site is not apparent, as Sladen & Tickell (1958), Hunter (1984a) and Parmelee (1992) all reported African recoveries (Table 3). An analysis of band recovery locations suggests that the number of African recoveries has decreased over the last 45+ years (Fig. 2). However, the total number of returns is also substantially lower; hence, the single African recovery from the 1980s represents 10% of all returns whereas the one recovery from the 1970s is only 2% of the returns (Fig. 2). It is therefore difficult to infer much from these data.

Re-sightings of Southern Giant Petrel fledglings during their first year of independence are low for all sites since banding programmes began in the late 1940s. However, analyses of these data over the last three to four decades suggest that recent rates of recovery are less frequent than those from earlier periods. From 1958–1964, 3.1% (129/4063) of all chicks banded at South Georgia were recovered during their first year (Hunter 1984a). During the 1970s, recovery rates of chicks banded at South Georgia (Hunter 1984a), Anvers Island (Parmelee 1992) and Iles Crozet (Voisin 1990) fell to 1.8% (56/3103). Recovery rates during the 1980s of chicks banded at Anvers Island, Iles Crozet, and King George Island (this study) decreased further to 0.5% (10/1902).

Although the decrease in recovery rates may be due, in part, to the pooling of data from different sites, it is also apparent within all sites, across years (Fig. 3). Furthermore, the two species of giant petrels were not distinguished in banding

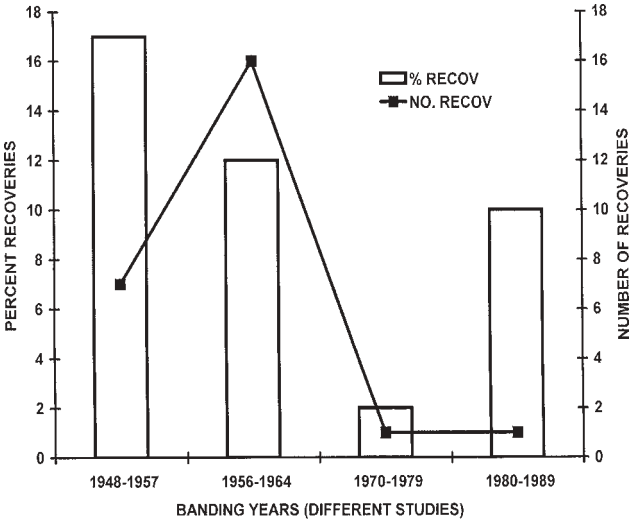

Fig. 2. *The percentage (bar graph) and numbers (line graph) of Southern Giant Petrel fledglings recovered from Africa between 1948 and 1989.*

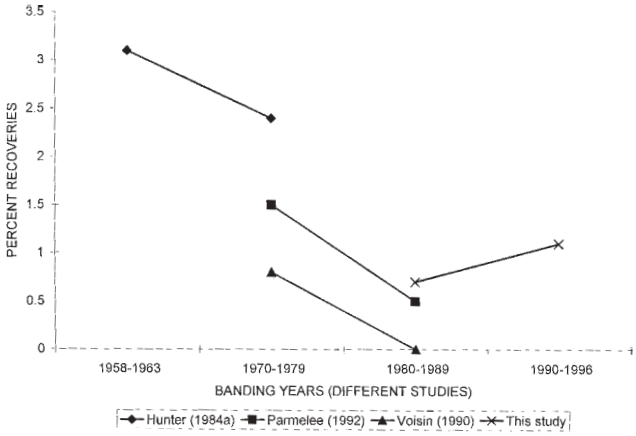

Fig. 3. *Long-term changes in the recovery rates of giant petrel fledglings at four major banding sites. All data are for Southern Giant Petrels only except for the 1958–1963 data from Hunter (1984a), which includes Northern Giant Petrels.*

records until the mid-1960s (Bourne & Warham 1966), and the early (1958–1964) data from South Georgia represent combined recoveries of both species. Later recoveries from the 1970s, when the two species were separated, found higher rates of recovery for Southern Giant Petrels than its congener in all years (Hunter 1984a), suggesting that the 3.1% mixed-species rate for the 1958–1964 period is a low estimate of Southern Giant Petrel recoveries.

It is difficult to account for the long-term decrease in recoveries of fledglings from these banding sites and there is no reason to believe that 'search effort' has diminished over this period. One possible explanation is that the enactment of tougher environmental laws, particularly in Australia and New Zealand, has reduced local, inshore food supplies, thereby affecting the wintering patterns of young birds. For example, Gibson (1973) reported a decrease in the numbers of young giant petrels (both species) observed inshore at Malabar, New South Wales after the curtailing of sewage discharge into the bay. Regulations enacted to reduce or eliminate the dumping

of garbage, sewage or fish offal from processing plants in coastal waters would dramatically affect the numbers of scavengers found inshore and could influence the probability of dead or weakened birds being washed ashore and recovered on beaches. Another possible reason for this decrease is that recoveries of giant petrels by longline fisheries are not reported for fear of reprisals by environmental groups.

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