Afr. J. mar. Sci. 25: 519–523
2003

EXCHANGE OF THE WANDERING ALBATROSS *DIOMEDEA EXULANS* BETWEEN THE PRINCE EDWARD AND CROZET ISLANDS: IMPLICATIONS FOR CONSERVATION

J. COOPER and H. WEIMERSKIRCH†*

Exchange of 61 wandering albatrosses *Diomedea exulans* has been recorded between the French Crozet Islands and the South African Prince Edward Islands, 1 068 km apart in the Southern Ocean. Most movements of banded birds (57) have been westwards, from the Crozets to the Prince Edwards. In all, 18 fledglings banded at Possession Island, Crozets, have bred at Marion Island, Prince Edwards, but only one fledgling from Marion Island has been recorded breeding on Possession. The wandering albatrosses of the two island groups form a metapopulation that ideally should be conserved as a single unit. It is suggested that France and South Africa collaborate through the Agreement on the Conservation of Albatrosses and Petrels to effect an improved conservation status for the wandering albatrosses of the two island groups.

Key words: conservation, *Diomedea exulans*, metapopulation, movements, Prince Edward and Crozet islands, Subantarctic

Banding of seabirds in the Southern Ocean has been undertaken both for demographic purposes and to elucidate movements away from breeding sites (e.g. Weimerskirch *et al*. 1985, 1997). With the advent of satellite-tracking and other data-acquisition devices (e.g. Jouventin and Weimerskirch 1990, Prince *et al*. 1992, Nicholls *et al*. 1995, Nel *et al*. 2002b), banding recoveries have become less important for understanding where seabirds (at least those large enough to carry devices) go when not at their breeding islands. However, recapturing banded birds is probably still the best way to study movements of birds (and thus immigration and emigration) between breeding populations (Weimerskirch *et al*. 1997).

The population dynamics of the wandering albatross *Diomedea exulans* have been studied at Marion Island, Prince Edward Islands, southern Indian Ocean, since 1984, by way of following banded individuals in study colonies (Nel *et al*. 2003). A similar study (commencing in the 1960s) is carried out at Possession Island, Crozet Islands (Weimerskirch *et al*. 1997). These studies show that the two populations have similar population dynamics and trends, thought due to being exposed to similar levels of mortality from longline fisheries in the Southern Ocean (Weimerskirch and Jouventin 1987, Weimerskirch *et al.* 1997, Nel *et al.* 2002a, b, 2003).

The two island groups are 1 068 km (great circle distance) apart and movements of wandering albatrosses between them have been reported for more than a quarter of a century (Mougin 1977, Gartshore *et al*. 1988). Weimerskirch *et al.* (1997) analysed records of 27 French-banded birds recaptured at Marion Island and showed that most were females, and that they included eight chicks banded at Possession which bred at Marion, showing true immigration. In contrast, they reported no Marion-fledged birds breeding at Possession. Since this analysis, the number of recorded movements between the two islands has more than doubled and, for the first time, a Marion Island fledgling has been recorded breeding at Possession Island. This paper updates the known information on inter-island movements of the wandering albatross metapopulation (Inchausti and Weimerskirch 2002) between the two island groups and considers how best to improve the species' conservation status at both.

METHODS

On an annual basis, breeding and non-breeding adult and fledgling wandering albatrosses at Marion Island (290 km^2; 46°54′S, 37°45′E) from 1976 and at Possession Island (146 km^2; 46°25′S, 51°45′E) from 1960 have been banded and checked for bands at various levels of intensity, as described by Weimerskirch *et al.* (1997) and Nel *et al*. (2003). A total of 5 965 wandering albatrosses (1 601 adults, 4 364 fledgelings) was banded at Marion Island over the period 1976–2000 (Nel *et al*. 2003). No wandering albatrosses

* Avian Demography Unit, University of Cape Town, Rondebosch 7701, South Africa. E-mail: jcooper@adu.uct.ac.za
† Centre d'Études Biologiques des Animaux Sauvages, Centre National de la Recherche Scientifique, F-79360, Villiers en Bois, France

Manuscript received June 2003; accepted July 2003

have been banded at Prince Edward Island (44 km^2; 46°38´S, 37°57´E). At both Marion and Posession islands, annual counts of all incubating birds are undertaken. A survey of the wandering albatross population of little-visited Prince Edward Island was undertaken in December 2001 (Ryan *et al*. 2003), during which most of the birds occupying a total of 1 687 nests were checked for bands.

All foreign bands found were carefully recorded and information exchanged via the South African and French banding schemes and by direct correspondence between the authors, creating a single, validated dataset, which was further checked against and augmented by published records (Berruti *et al*. 1975, Barré *et al.* 1976, Burger and Morant 1977, Mougin 1977, Brown and Oatley 1982, Weimerskirch *et al*. 1985, Gartshore *et al.* 1988).

RESULTS

Since banding commenced at the two islands, a total of 57 Possession-banded wandering albatrosses (28 sexed as females, 15 as males) has been recaptured at the Prince Edward Islands (55 at Marion Island and two, one of which was dead, at Prince Edward Island). Age-class at banding is unknown for one French-banded bird recaptured as a breeding male at Marion Island. This bird has therefore been left out of the following analyses.

A total of 29 birds (14 females, 8 males, 7 unsexed) banded as chicks at Possession Island has been recaptured at Marion Island. Of these, 18 (7 identified as females, 6 as males) have been recorded breeding. A few birds that bred within study colonies have been recorded breeding up to seven times, but most have been recorded breeding only once or twice. Years elapsed to first breeding records range from 7 to 28 years (average 12.7 ± 5.3 years), with no significant difference between the sexes. A temporal analysis grouping first-breeding records into five-year periods showed no discernible difference between the sexes, although the sample was small. Most first-breeding records date from the 1990s, with only one earlier, a female, in 1975 (Mougin 1977). Five Possession fledglings (4 females, 1 male) recaptured at Marion as non-breeders have been subsequently recorded at Possession Island, four as breeding birds.

A further 27 birds (14 females, 5 males) banded as adults at Possession Island (26 as non-breeders and presumed to be immatures) have been recorded at the Prince Edward Islands (25 at Marion, 2 at Prince Edward). Of these, 17 (9 identified as females, 4 as males) have been recorded subsequently breeding at Marion Island. Two of these birds had previously been recorded breeding at Possession Island, one male with an intervening gap of 31 years, the second a female with an interval of 17 years.

Overall, 35 (61%) of the 57 birds banded at Possession have been recorded breeding (incubating or attending a chick) at Marion Island. This total, which includes 16 females and 10 males, does not include a number of birds variously reported as displaying, with a partner or attending an empty nest, so the actual percentage that has bred is likely to be somewhat higher.

Nine (0.63%) of 1 426 incubating wandering albatrosses checked at Marion Island in January 2003 carried bands attached at Possession Island.

In contrast, only four wandering albatrosses banded at Marion Island have subsequently been recorded at Possession Island. Three Marion fledglings were recaptured (two once each, the third twice) as non-breeders aged 5–7 years in the mid-1980s (Gartshore *et al.* 1988). A fourth bird, a female, banded as a chick at Marion was found breeding on Possession aged 7 years in 2002. No birds banded as non-breeders at Marion Island have yet been recaptured at Possession Island.

DISCUSSION

The annual breeding populations of wandering albatrosses at Marion and Possession Islands have fluctuated over the periods of their study (Weimerskirch *et al*. 1997, Woehler *et al*. 2001, Nel *et al*. 2002a). The most recent counts made in the 2001/02 and 2002/03 breeding seasons give annual populations at Marion of 1 869 and 1 593 pairs respectively (Crawford *et al*. 2003), and at Possession of 394 pairs in 2002/03 (HW unpublished data), only a quarter of that at Marion in the same season. The annual breeding population at Prince Edward Island was estimated as 1 850 pairs for the 2001/02 season (Ryan *et al*. 2003). The total annual breeding population of the Crozet Islands is 1 734 pairs (Weimerskirch and Jouventin 1987), approximately half that of the Prince Edward Islands.

Movements of wandering albatrosses between the two island groups are not easy to interpret. For example, it cannot be assumed that all Possession-banded non-breeders fledged from that island; their numbers may include Marion fledglings that visited Possession as non-breeders, when they were caught and banded. However, given that 57 Possession birds have been recorded as making the westward journey to the Prince Edward Islands, compared with the four from Marion that moved east to Possession, it is reasonable to assume that the majority of the Possession-

banded birds did indeed fledge from that island. This fits the fact that some of these birds commenced breeding at Possession (and thus their assumed natal island) after visiting Marion without being recorded breeding there. This assumption is partially confounded by known or likely differences in banding effort (few non-breeding wandering albatrosses are banded at Marion Island) and search intensity, and by the important fact that, whereas Marion Island supports approximately half the wandering albatrosses of the Prince Edward Island group, Possession Island supports only 20% of the total Crozet wandering albatross population. This means that, even at similar search intensities at the two islands where research programmes exist, the chances of finding west-moving birds is far higher than the reverse. If birds prefer to recruit to islands with larger colonies (as the preponderance of movements from Possession to Marion might suggest), then it may be that more Marion-banded birds have also visited, and perhaps recruited to, Ile au Cochons in the Crozet group, which supported 1 060 wandering albatross pairs in 1981 (Weimerskirch and Jouventin 1987), than have done so to Possession, with its markedly smaller population.

Even with the above imponderables, it seems clear that most inter-island group movements, and importantly breeding interchanges, have been in a westerly direction to Marion Island. Further, most movements have been by females, as shown by Weimerskirch *et al*. (1997) for a smaller sample. However, given that males are more faithful to natal sites when recruiting to breed than are females (Weimerskirch *et al*. 1997 for Possession Island, unpublished data for Marion Island), the fact that 35% (15/43) of sexed Possession-banded birds recaptured at Marion Island were males is notable, as are the essentially equal numbers (7 females, 6 males) of Possession fledglings that moved to breed at Marion. With the exception of the 1970s female that made this movement in the 1970s (Mougin 1977), all breeding interchanges have taken place from the 1990s onwards. It might be postulated that an unequal sex-bias in longline-fishing mortality, which is assumed to have caused a preponderance of males in the population in the past few decades (Weimerskirch and Jouventin 1987, Nel *et al*. 2002a, 2003), has led to an increasing number of pre-breeding males in recent years being unable to find partners at their natal island, in turn causing them to emigrate to another island, where its larger population makes it more likely that a partner will be found. However, an increased search effort at Marion Island in the 1990s than earlier confounds this assumption to a degree.

Records of individual birds breeding at both island groups are unexpected for a species that shows high fidelity to its first breeding site (Weimerskirch *et al.* 1997 for Possession, unpublished data for Marion Island). Weimerskirch *et al.* (1997) report three females that bred on two different islands in the Crozet Islands, but the two birds reported here appear to be the first records of individual wandering albatrosses breeding at two different island groups, in this case a little over 1 000 km apart.

The average age of known first breeding of 12.7 years is more than the overall 9.9 years recorded at Marion Island (Nel *et al*. 2003), but closer to the overall 11.4 years reported for Possession Island (Weimerskirch and Jouventin 1987). Because few Possession fledglings recruited to study colonies at Marion Island, some may have been overlooked as breeding birds prior to their first recapture, leading to an increased figure.

Based on the level of breeding interchange, the wandering albatrosses of the Prince Edward and Crozet Island groups may be regarded as forming a metapopulation (Inchausti and Weimerskirch 2002). On the evidence presented, there appears to be an ongoing net movement of wandering albatrosses from Posession to Marion, although it is as yet not known if this applies to the two island groups as a whole. Given the Vulnerable status of the species (BirdLife International 2000), it is recommended that this metapopulation should be conserved as single unit. This will require collaboration between the French and South African authorities holding responsibility for managing the islands and their biota, including the wandering albatross, as well as between the scientists studying the species at the two island groups. Some level of sharing of research and management information between France and South Africa already takes place within several international fora, notably the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), mainly through its *ad hoc* Working Group on Incidental Mortality Arising from Fishing (WG-IMAF; SC-CAMLR 2002) and through the Scientific Committee on Antarctic Research's now-named Group of Experts on Birds (Woehler *et al*. 2001, SCAR-BBS 2002). Scope for further collaboration exists via the Food and Agriculture Organization of the United Nations' International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries, which recommends the production of National Plans of Action (NPOA-Seabirds; FAO 1999, Cooper *et al.* 2001).

However, perhaps the most promising forum for coordinating research and management of wandering albatrosses at the Crozet and Prince Edward islands is via the Agreement on the Conservation of Albatrosses and Petrels (ACAP) of the Bonn Convention on Migratory Species (Cooper and Ryan 2001, www.ea.gov.au/coasts/species/seabirds/albatross). South Africa has

ratified the Agreement (Crawford and Cooper 2003), but France has not yet ratified (Anon. 2001, 2003). ACAP is expected to come into force during the course of 2003, three months after five countries have ratified it. It is suggested that France and South Africa could produce a joint background paper for the first Meeting of Parties of ACAP, expected to be held in 2004, that sets out how they may work together to improve the conservation status of their shared metapopulation of wandering albatrosses. This paper could also consider the other species of procellariiform seabirds included within ACAP, some of which may also form metapopulations shared by the two island groups, based on observations of interchange of banded individuals, such as of the southern giant petrel *Macronectes giganteus* (Crawford and Cooper 2003). The paper could cover such matters as joint and/or shared sea patrols to detect and deter Illegal, Unreported and Unregulated (IUU) fishing by longline vessels within the island groups' Exclusive Economic Zones (EEZs), perhaps by way of a joint Plan of Action (FAO 2001); developing and adopting NPOA-Seabirds with similar regulations to enforce the use of mitigation measures by longline fisheries; sharing information and ideas in relation to producing management plans for the island groups; considering the feasibility and value of declaring marine protected areas surrounding the two island groups; and the exchange of ornithologists and managers between the two countries.

South Africa has produced a draft NPOA-Seabirds and is in the process of reviewing its management plan for the Prince Edward Islands (Cooper and Ryan 2002, Crawford and Cooper 2003). Of course, such collaboration as mooted here could lead to improvements in the conservation status of the other species of co-occurring albatrosses, as well as all the seabirds that breed at both island groups. All such activities would be more likely to bear fruit once the Agreement on the Conservation of Albatrosses and Petrels comes into force.

ACKNOWLEDGEMENTS

Thanks are due to the many dedicated researchers and field assistants who have counted and examined for banded wandering albatrosses at Marion and Possession Islands over many years, often under arduous conditions. Dr R. J. M. Crawford and the Branch: Marine & Coastal Management, South African Department of Environmental Affairs and Tourism (DEAT), are thanked for respectively leading and sponsoring the December 2001 Expedition to the Prince Edward Islands. We thank D. Besson and D. Oschadleus for help with the French and South African data bases. Research at the Prince Edward Islands is supported financially and logistically by the South African National Antarctic Programme of the DEAT. Research at the Crozet Islands is supported by Terres Australes et Antarctic Françaises, Institut Française pour la Recherche et la Technologie Polaires and the Centre National de la Recherche Scientifique. The views espoused in this paper remain those of its authors and do not necessarily reflect official government policy of either country.

LITERATURE CITED

ANON. 2001 — The signing ceremony. *ACAP News* **1**: 1–2.
ANON. 2003 — Ecuador ratifies ACAP. *CMS Bull*. **17**: p. 20.
BARRÉ, H., MOUGIN, J-L., PRÉVOST, J. and M. VAN BEVEREN 1976 — Bird ringing in the Crozet Archipelago, Kerguelen, New Amsterdam and St Paul Islands. *The Ring* **86/87**: 1–16.
BERRUTI, A., BURGER, A. E., WILLIAMS, A. J. and W. R. SIEGFRIED 1975 — Bird ringing on Marion Island. *S. Afr. J. Antarct. Res*. **5**: 50–52.
BIRDLIFE INTERNATIONAL 2000 — *Threatened Birds of the World*. Barcelona and Cambridge, UK; Lynx Edicions and BirdLife International: 852 pp.
BROWN, C. R. and T. B. OATLEY 1982 — Bird ringing at Marion and Prince Edward Islands, 1977–1982. *S. Afr. J. Antarct. Res.* **12**: 45–48.
BURGER, A. E. and P. D. MORANT 1977 — Bird ringing on Marion Island, 1975–1977. *S. Afr. J. Antarct. Res.* **7**: 26–27.
COOPER, J., CROXALL, J. P. and K. S. RIVERA 2001 — Off the hook? Initiatives to reduce seabird bycatch in longline fisheries. In *Seabird Bycatch: Trends, Roadblocks and Solutions*. Melvin, E. F. and J. K. Parrish (Eds). Fairbanks; University of Alaska Sea Grant: 1–32.
COOPER, J. and P. G. RYAN 2001 — The Agreement on the Conservation of Albatrosses and Petrels. *S. Afr. J. Sci*. **97**: 78–79.
COOPER, J. and P. G. RYAN 2002 — *Draft South African National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries*. www.environment.gov.za
CRAWFORD, R. J. M. and J. COOPER 2003 — Conserving surface-nesting seabirds at the Prince Edward Islands: the roles of research, monitoring and legislation. *Afr. J. mar. Sci*. **25**: 415–426.
CRAWFORD, R. J. M., COOPER, J., DYER, B. M., GREYLING, M. D., KLAGES, N. T. W., RYAN, P. G., PETERSEN, S. L., UNDERHILL, L. G., UPFOLD, L., WILKINSON, W., DE VILLIERS, M. S., DU PLESSIS, S., DU TOIT, M., LESHORO, T. M., MAKHADO, A. B., MASON, M. S., MERKLE, D., TSHINGANA, D., WARD, V. L. and P. A. WHITTINGTON 2003 — Populations of surface-nesting seabirds at Marion Island, 1994/95–2002/03. *Afr. J. mar. Sci*. **25**: 427–440.
FAO 1999 — *International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries. International Plan of Action for the Conservation of Sharks. International Plan of Action for the Management of Fishing Capacity*. Rome: FAO: 26 pp.
FAO 2001 — *International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing*. Rome; FAO: 24 pp.

GALES, R. 1998 — Albatross populations: status and trends. In *Albatross Biology and Conservation*. Robertson, G. and R. Gales (Eds). Chipping Norton; Surrey Beatty & Sons: 20–45.

GARTSHORE, N. A., COOPER, J. and S. HUNTER 1988 — Bird ringing at Marion and Prince Edward Islands, 1982–1987; with an analysis of movements since 1951. *S. Afr. J. Antarct. Res.* **18**: 23–29.

INCHAUSTI, P. and H. WEIMERSKIRCH 2002 — Dispersal and metapopulation dynamics of an oceanic seabird, the wandering albatross, and its consequences for its response to long-line fisheries. *J. Anim. Ecol.* **71**: 765–770.

JOUVENTIN, P. and H. WEIMERSKIRCH 1990 — Satellite tracking of wandering albatrosses. *Nature* **343**: 215–223.

MOUGIN, J-L. 1977 — Nidification à l'île Marion (46°53´S, 37°52´E) d'un Grand Albatros (*Diomedea exulans* L.) né à l'île de la Possession, archipel Crozet (46°25´S, 51°45´E). *C. R. Acad. Sci. Paris* **274**: 2277–2280.

NEL, D. C., RYAN, P. G., CRAWFORD, R. J. M., COOPER, J. and O. HUYSER 2002a — Population trends of albatrosses and petrels at sub-Antarctic Marion Island. *Polar Biol.* **25**: 81–89.

NEL, D. C., RYAN, P. G., NEL, J. L., KLAGES, N. T. W., WILSON, R. P. and G. ROBERTSON 2002b — Foraging interactions of wandering albatrosses *Diomedea exulans* breeding on Marion Island with long-line fisheries in the southern Indian Ocean. *Ibis* **144**: E141–E145.

NEL, D. C., TAYLOR, F., RYAN, P. G. and J. COOPER 2003 — Population dynamics of the wandering albatross *Diomedea exulans* at Marion Island: longline fishing and environmental influences. *Afr. J. mar. Sci.* **25**: 503–517.

NICHOLLS, D., MURRAY, D., BATTAM, H., ROBERTSON, G., MOORS, P., BUTCHER, E. and M. HILDEBRANDT 1995 — Satellite tracking of the wandering albatross *Diomedea exulans* around Australia and in the Indian Ocean. *Emu* **95**: 223–230.

PRINCE, P. A., WOOD, A. G., BARTON, T. and J. P. CROXALL 1992 — Satellite tracking of wandering albatrosses (*Diomedea exulans*) in the South Atlantic. *Antarct. Sci.* **4**: 31–36.

RYAN, P. G., COOPER, J., DYER, B. M., UNDERHILL, L. G., CRAWFORD, R. J. M. and M. N. BESTER 2003 — Counts of surface-nesting seabirds breeding at Prince Edward Island, summer 2001/02. *Afr. J. mar. Sci.* **25**: 441–517.

SCAR-BBS 2002 — Scientific Committee on Antarctic Research Working Group on Bird Biology Subcommittee. Minutes of Meeting, 9–13 June 2002, Jena, Germany. *Mar. Ornithol.* **30**: 97–106.

SC-CAMLR 2002 — *Report of the Twenty-first Meeting of the Scientific Committee*. Hobart; Commission for the Conservation of Antarctic Marine Living Resources: 524 pp.

WEIMERSKIRCH, H., BROTHERS, N. and P. JOUVENTIN 1997 — Population dynamics of wandering albatross *Diomedea exulans* and Amsterdam albatross *D. amsterdamensis* in the Indian Ocean and their relationships with longline fisheries: conservation implications. *Biol. Conserv.* **79**: 257–270.

WEIMERSKIRCH, H. and P. JOUVENTIN 1987 — Population dynamics of the wandering albatross, *Diomedea exulans*, of the Crozet Islands: causes and consequences of the population decline. *Oikos* **49**: 315–322.

WEIMERSKIRCH, H., JOUVENTIN, P., MOUGIN, J-L., STAHL, J-C. and M. VAN BEVEREN 1985 — Banding recoveries and the dispersal of seabirds breeding in French austral and Antarctic territories. *Emu* **85**: 22–33.

WOEHLER, E. J., COOPER, J., CROXALL, J. P., FRASER, W. R., KOOYMAN, G. L., MILLER, G. D., NEL, D. C., PATTERSON, D. L., PETER, H-U., RIBIC, C. A., SALWICKA, K., TRIVELPIECE, W. Z. and H. WEIMERSKIRCH 2001 — *A Statistical Assessment of the Status and Trends of Antarctic and Subantarctic Seabirds*. [Cambridge]; SCAR: 43 pp.

A wandering albatross with its chick at Marion Island (photo L. Upfold)