

# THE KNOWN HISTORY AND MOVEMENTS OF THE ROSEATE TERN *STERNA DOUGALLII* IN SOUTH AFRICA AND THE WESTERN INDIAN OCEAN

A.J. TREE

*Institute for Environmental and Coastal Management, University of Port Elizabeth, PO Box 1600, Port Elizabeth, 6000, South Africa  
(tonytree@zeane.com)*

*Received 15 May 2004, accepted 25 April 2005*

## SUMMARY

TREE, A.J. 2005. The known history and movements of the Roseate Tern *Sterna dougallii* in South Africa and the western Indian Ocean. *Marine Ornithology* 33: 41-47.

An attempt is made to bring together the data from the literature, recent studies and individual records of the Roseate Tern *Sterna dougallii* in South Africa and the western Indian Ocean as well as to determine the movements of various populations. There appear to be two major populations in the subregion, that of the northwestern Indian Ocean and that in the southwestern sector. The northwestern population is currently recognised as belonging to the subspecies *S. d. arideensis*, and the southwestern to a genetic intermediate between the Atlantic and the Indo-Pacific populations. A recent genetic study of seven populations from around the world indicates two lineages, that of the Indo-Pacific and that of the north Atlantic, showing an earlier divergence with South African birds, an intermediate form that evolved during a more recent introgression of the two forms. It is suggested that Indo-Pacific birds should be recognised as of one subspecies, *S. d. gracilis*, with Atlantic birds remaining as *S. d. dougallii*. Further study is required on other populations in the southwestern sector of the Indian Ocean to ascertain whether they all fall into the intermediate category shown for South African birds as suggested by a study of museum specimens. All breeding populations appear to be unstable, and numbers may fluctuate widely at any given locality from season to season. Banding and flagging studies in South Africa show that a small percentage of birds return to breeding islands in subsequent seasons. It is suggested that considerable population shifts occur, with movements of individuals within each of the two sectors, and that population figures derived from summing peak counts for each colony in different years are unlikely to be accurate. Further banding and genetic studies should be undertaken at a variety of sites, together with careful observations at colonies to search for marked birds.

Key words: Roseate Tern, *Sterna dougallii*, South Africa, western Indian Ocean, breeding colonies, population shifts

## INTRODUCTION

The Roseate Tern *Sterna dougallii* is not considered globally threatened (BirdLife International 2004), but regionally it has been variably classified as Endangered and Threatened (Gochfeld & Burger 1998). Only the Australian population of this bird is considered to be in a healthy position, its previous size having been seriously underestimated (I.C.T. Nisbet, Roseate Tern Workshop, Wexford, Ireland, 2003). The only population in the western Indian Ocean that has been formally categorized (as Endangered) is that of South Africa (Brooke 1984, Underhill 2000, Tree & Klages 2003).

Accounts of the occurrence of the Roseate Tern in the western Indian Ocean (Fig. 1) are fragmented throughout the literature, and no recent published attempt has been made to assess the overall population found in the region. Records given in the present account have been gathered over a considerable time span and are unlikely to represent the true present-day picture because (for instance) very little work has been carried out along the extensive Tanzanian coastline. The movements of the various populations are poorly understood. None appears to be entirely sedentary, and there may be considerable dispersion of younger birds. No western Indian Ocean populations appear to be totally migratory, although the South African birds range from locally nomadic to dispersive and migratory.

Lashko (2004) undertook mitochondrial DNA sequences and micro-satellite genotyping of Roseate Terns using material from Australia, Japan, Seychelles, South Africa, Azores, Ireland and the United States. That work revealed two distinct lineages of Roseate Tern: from the Atlantic and from the Indo-Pacific. These lineages represent a significant historical divergence, with continental Africa implicated as the major long-term barrier to gene flow between the two ocean basins. South African birds are the result of secondary contact and introgression of the two lineages. For the Indo-Pacific population it is suggested that the three or four currently recognised subspecies should be merged to form a single subspecies, *S. d. gracilis*. Breeding birds in the Seychelles are considered divergent from those of the eastern Indian Ocean and Pacific Ocean, suggesting that the Indian Ocean serves as a current barrier to gene flow.

The "old" subspecies that appeared in the literature are used here to represent the populations of the western Indian Ocean. Gochfeld & Burger (1996) have suggested that the five subspecies named are not necessarily valid. The oldest name in use for birds of the Indo-Pacific is *S. d. gracilis* (Gould 1845), and perhaps in the light of Lashko (2004) we should return to the use of nominate *dougallii* for the Atlantic and *gracilis* for the Indo-Pacific, while treating birds from the southern parts of the western Indian Ocean as true intermediates.

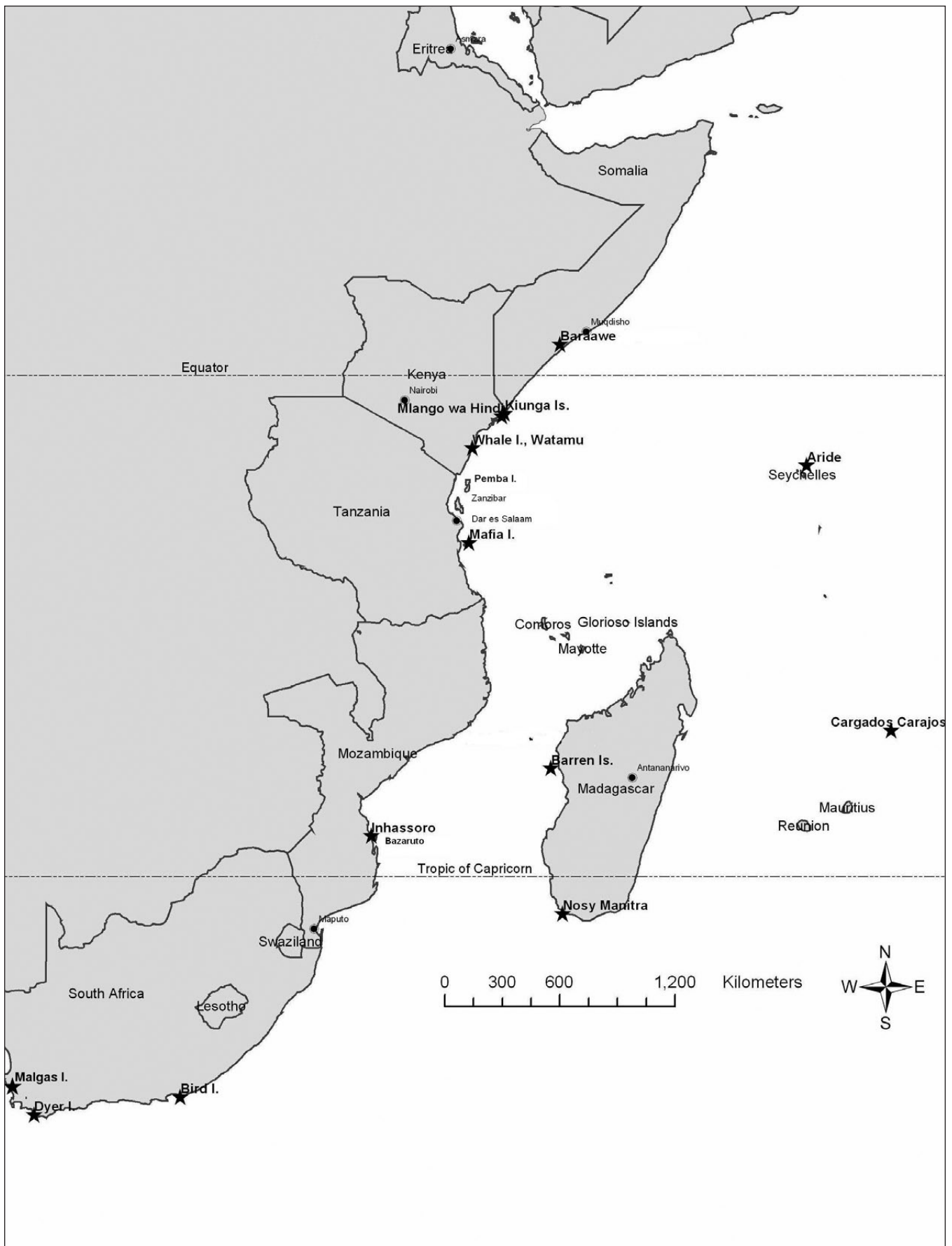


Fig. 1. The western Indian Ocean, showing localities named in the text.

Here, an attempt is made to bring together data from the literature, recent studies and individual records of the Roseate Tern in South Africa and the western Indian Ocean and to determine the movements of various populations.

## METHODS

Most records cited have been extracted from published literature; the balance are taken from personal observations and from contributions from other field observers. Banding studies, using 4.3-mm stainless steel SAFRING bands, have been carried out on Bird Island, Algoa Bay, Eastern Cape, South Africa since 1998, with coloured Darvic flags added to the opposite leg since 2000. All adults are given a green flag on the left leg; the young are given a year-coded colour on either the left or right leg. Intensive observations, using telescopes, are made on Bird Island as well as on the mainland coastline to determine banded and flagged birds present.

## REGIONAL REVIEW

### South Africa

The existence of a breeding population of Roseate Terns in South Africa was first reported for the Bird Island group, composed of Bird, Stag and Seal Islands (33°50'S 26°17'E), at the eastern extremity of Algoa Bay in November 1936 (Courtinay-Latimer 1937). On her first visit, Courtinay-Latimer reported "thousands" of Roseate Terns (presumably non-breeding) on Stag Island, and she was informed by the residents of the main island that the birds remained throughout the year. (In the light of present knowledge, year-round was unlikely, and there was likely confusion with migratory Palaeartic terns.)

In August 1937, Courtinay-Latimer again visited the islands and reported hundreds of birds and nests in profusion. In those days tern eggs were considered a delicacy by the islanders (Courtinay-Latimer 1937). No further mention is made of these birds until 1971 when G.J.B. Ross (pers. comm.) estimated that about 70 pairs were present.

Further work during the mid-1970s indicated that 75–135 pairs occurred in Algoa Bay, with breeding mainly on St Croix Island, a rocky island considered generally unsuitable for breeding Roseate Terns because it lacks vegetation. Breeding success there was very low and unlikely to sustain the population (Randall *et al.* 1991). The upper figure of 135 pairs is now considered unlikely, because it was calculated not on actual counts of breeding birds, but on certain assumptions, some of which may no longer be considered valid (e.g. a closed population).

Bird Island in Algoa Bay is presently home to the largest gannet population in the world, with possibly some 150 000 Cape Gannets *Morus capensis* at the peak of the breeding season, a population that has shown an enormous increase in recent years (AJT pers. obs.). The island is also home to a fluctuating population, ranging up to 5400 breeding pairs, of African Penguins *Spheniscus demersus* (N.T.W. Klages pers. comm.). Both of these species compete for breeding space on the island, and the former tends to destroy all vegetation in the vicinity of the colony, including the area holding the major Roseate Tern breeding site up to 2001.

Guano collection began on Bird Island in 1844, and the first lighthouse was occupied in 1852. From then until 1989, the island

was permanently inhabited. Guano collection ceased in 1989, although the islands in the group had fallen under the jurisdiction of Eastern Cape Nature Conservation as a formally declared nature reserve since 1987 (Urquhart & Klages 1996). The reserve was transferred in 2003 to the South African National Parks, where it now forms part of the Greater Addo National Park. It has also recently been listed as one of five marine reserves to be established around the South African coastline. In 1986, Roseate Terns were estimated at 134 pairs (Randall *et al.* 1991). By 1996, 152 active nests were reported by the then conservator, S. Röhm (pers. comm.). In 1998, 180 pairs were estimated to be present, increasing to 210–220 pairs in 1999, and to 240–250 pairs in 2000 and 2001 (Tree & Klages 2003). This increase is considered too rapid for normal recruitment. The numbers attempting to breed in 2002 were not ascertained, but very wet weather during July and August caused a total breeding failure (Tree 2003a). In July 2003, only 70–75 pairs were on Bird Island and *ca.* 30 pairs on St Croix Island, with similar figures estimated in August/September 2004 (AJT & N.T.W. Klages pers. obs.). Inclement weather conditions have been the cause of failure of some past breeding attempts (Randall & Randall 1978).

European Rabbits *Oryctolagus cuniculus* were thought to have been introduced onto Bird Island around the mid-1800s, and this introduction had the effect of destroying the vegetation, also making the island unsuitable for breeding Roseate Terns. The rabbits were finally eradicated in 1992 (Urquhart & Klages 1996). Presumably, the rabbits were one of the reasons that the birds moved to the smaller Stag Island, where rabbits did not occur.

Elsewhere in South Africa, a small colony was reported on Dyer Island in the Western Cape (640 km west of Bird Island) in 1909 (none was present in the previous 29 years). This colony persisted until 1971, when breeding apparently ceased (Randall & Randall 1978), possibly because of continued disturbance from guano collection, which continued until 1985 (Crawford 1997). Small numbers again started to breed there in the 1990s, but breeding success continues to be low. In 2002, an estimated 17 pairs were present, with 16 pairs in 2003 rearing at least eight young (B.M. Dyer pers. comm.). Only seven pairs were present in July 2004 (pers. obs.).

Several colour-flagged birds from Bird Island have been seen on Dyer Island, some apparently breeding, and also farther west on Malgas Island (900 km from Bird Island), where breeding has not been observed. Access to the Dyer Island colony is forbidden because of intensive egg and chick predation by Kelp Gulls *Larus dominicanus*; all observations are made at a distance from behind a dry-stone wall (Tree & Klages 2003, A.J. Venter & B.M. Dyer pers. comm.).

South African breeding birds appear closest to nominate *dougallii* of the north Atlantic (Clancey 1965, Tree & Klages 2003). They differ from *arideensis* (= *bangsi*?) of East Africa in being larger, darker on the upperparts, with a longer tail and bill, and less red on the bill during breeding. The affinities of Madagascan birds are far from clear, although Moreau (Milon 1950) considered them to be larger than *arideensis* from the Seychelles. Morphometric and some plumage data obtained from the Paris Museum, France (J.M. Pons), the Natural History Museum, Tring, UK (K. Cook) together with photographs from the Barren Islands, Madagascar (F. Hawkins) show close affinities to the South African birds.

### Madagascar

The South African population appears to be quite isolated, with the nearest presently known extant colony discovered in July 1998 on two of the Barren Islands, off west-central Madagascar, some 2400 km from the Bird Island colony (Tree & Klages 2003, F. Hawkins pers. comm.). This population had decreased in size from the 2000 pairs estimated in 1982 (Project ZICOMA 2001) to an estimated 1480 pairs in 1998 (F. Hawkins pers. comm.). The situation in southwest Madagascar, where 4000 pairs were found breeding on Nosy Manitra in 1948 (Milon 1950) and where a seasonal fishing village is now established during the terns' breeding season (F. Hawkins pers. comm.) is not clear; this island is situated about 1750 km from Bird Island. Because Domestic Goats *Caprus hircus* are now permanently established on the island, it is unlikely that terns breed there now. Elsewhere in Madagascar, 50 pairs were found on the east coast on an island 30 km south of Tamatave in 1971 (Salvan 1971). Although seen in varying numbers in the north, no sign of these birds breeding has been seen (Rand 1936, J.C. Sinclair pers. comm.). Some 500 birds, not yet breeding but in breeding colouration, were noted at a potential site on Nosy Faty in the Cape Anorontany Archipelago of northern Madagascar in 1997; about 1000 individuals were also observed in the area of Ile Sainte Marie in June 1999, where there are potential breeding sites (T. Dodman *in litt.*). A probable nocturnal roost of 800 birds, of which more than 600 were in full nuptial and 30–40 in fresh juvenile plumage, was seen on stacks off Cape Masoala in northeast Madagascar on the evening of 8 November 2004 (J.C. Sinclair pers. comm.).

### Mozambique

In June 2003, a group of 60 pairs were seen displaying intensely on a sand-spit south of Inhassoro, opposite Bazaruto Island, about 1650 km from Bird Island, South Africa (F. Couto pers. comm.), and it appears likely that breeding followed somewhere on the Bazaruto Archipelago. This happened at a time when breeding birds had already returned to South Africa. No historical evidence describes Roseate Terns breeding in Mozambique, and it is only quite recently that this species was found roosting in mid-summer in small numbers amongst other terns on Bazaruto Island (Kohler & Kohler 1996).

### Tanzania

Breeding has been reported intermittently off Zanzibar—e.g. between 550 and 700 nests found on offshore islets in 1994 (Iles 1994) and Pemba (Vaughan 1929–1930) and off Dar es Salaam, where at least 300 birds established an “occasional” breeding colony in 1967, when a specimen found dead showed characteristics ascribed to *S. d. korustes* of the Indian subcontinent (Thomas & Elliott 1973). This bird may well turn out to be the same subspecies as those from Madagascar and South Africa, as have other specimens collected from Tanzania and deposited in the British Museum of Natural History. A small colony bred on Mafia Island in August 1978 (Richards 1979) and in 1980 (Britton 1980). In 2003, some 150 pairs returned to breed at the same island, while other birds were found at Songo-Songo (M. Richmond, Tanzaniabirdnet).

### Kenya

The Roseate Tern forms large but irregular colonies in Kenya. In 1961 some 1195 pairs bred on an islet off Kiungu Island (Fogden 1964). In 1970, ca. 5000 pairs bred, but in 1971, five pairs were found on the same islet, and only 70 pairs over the whole area. At Whale Island, Watamu, Roseate Terns bred in 1967, 1971

and 1973, but not between 1968 and 1970 or in 1972 (Britton & Brown 1974). In 1970, 8000 pairs of Roseate Terns were estimated breeding at Mlango wa Hindi, less than 250 km north of Whale Island, but in 1971, only 0.1% of the previous years' numbers bred, when they were again breeding on Whale Island (Britton & Brown 1974). Large numbers were recorded breeding at Whale Island in July 1976, but they had deserted their eggs by August. No birds bred at this site in 1977 (Donnelly 1978). In October 1997, some 400 adults with 100 young were noted (T. Dodman *in litt.*). Birds were recorded breeding on Whale Island in 2000, but not again until 2003, when 1400–1500 pairs were estimated to be present (C. Jackson pers. comm.).

In both Kenya and Tanzania, large flocks of Roseate Terns, sometimes numbering many thousands, may be found feeding offshore, but the provenance of these birds has not been established (Britton & Brown 1974, N. Baker *in litt.*). However, hundreds of islets along the Tanzanian coast are rarely visited (N. Baker *in litt.*).

### Somalia

The only published breeding records appear to be of “a few” breeding near Brava, south of Mogadishu, in 1941 (North 1944) and some 600 and 1000 birds attempting to breed farther north near Mogadishu in 1979 and 1980, respectively (Ash & Karani 1981).

### Seychelles

On Aride Island, numbers increased from 2500 breeding pairs in 1974 to a peak of 9000 pairs in 1984 when breeding was again successful. From 1985 to 1988, breeding failed and the numbers of breeding birds had dwindled to 950 pairs in the latter year (Avery 1989). The birds have never recovered their former abundance and still show considerable variation in numbers (0–1242 pairs between 1987 and 2001, inclusive; Ramos *et al.* 2002). Elsewhere in the Seychelles, about 150 pairs were observed on African Banks (Skerret *et al.* 2001), where Ridley & Percy (1966) reported 250–300 pairs in 1966, Feare (1979) reported 21 nests in 1974, and Feare & Gill (1997) found 82 nests in 1997. It is unlikely that any of these fledge young, because the island is heavily poached by fishers. Etoile in the Amirantes supports ca. 150 pairs, and the species may also breed on two other islands on the Bancs du Providence (Skerrett *et al.* 2001). Ridley & Percy (1958) mentioned a large Roseate Tern colony on Ils aux Vaches (Grand Anse, Mahe). This is a small rocky island which appears unsuitable for Roseate Terns.

### Mauritius

The Cargados Carajos (or St Brandon) shoals stretch from about 345 km north of Mauritius along the Seychelles–Mauritius Ridge towards the Seychelles. They are visited infrequently by ornithologists. Although the Roseate Tern was reported to breed in “large numbers” (Watson *et al.* 1963), no specific counts are available, and certainly numbers are low post-breeding (Nisbet 1980). In January 1956, several hundred young at all stages from freshly hatched to weak fliers were present (Newton 1958). Small numbers of non-breeders were present on five islets in July–August 1971, and breeding took place from November 1971 to January 1972 (Williams & Rowlands 1980). K. Swinnerton saw at least 100 birds, along with small numbers on other islets in late January/early February 1994 (Safford 2001). A figure of about 400 pairs is estimated (Safford 2001). The all-red bills of the adults feeding young (Newton 1956) indicate that these birds belong to the subspecies *S. d. arideensis*.



There appear to be no other extant breeding populations in the western Indian Ocean. Vagrancy to other islands, such as Mauritius, is uncommon (up to 17 birds), but the species is a regular migrant in the period November to March (Temple 1976). The species' occurrence at Rodrigues appears limited (Newton 1958, Watson *et al.* 1963). In the Seychelles, birds in breeding plumage are sometimes seen on Bird Island, where they do not breed, and birds in non-breeding plumage are seen fairly commonly along the coasts of almost all islands out of the breeding season (Skerret *et al.* 2001).

## DISCUSSION

Most breeding colonies of Roseate Terns in the western Indian Ocean fall within the tropics. Bird Island, South Africa, is subtropical, but is close to the warm southward-flowing Mozambique current. It is becoming apparent that no western Indian Ocean colonies are stable and that breeding at them may not occur every year, as suggested by Britton & Brown (1974), or that individuals may not always breed every year, a possibility suggested by Hatch (2002) for the Arctic Tern *S. paradisaea*. Ramos *et al.* (2002) also demonstrated variable breeding of Roseate Terns on Aride Island in the Seychelles. Another possibility is that population shifts occur from year to year within the bird's geographic range.

Over the nine-year period 1996–2004, the breeding population on Bird Island and nearby St Croix has fluctuated from about 100 to 240 pairs. In the years 1998–2004, a total of 212 adult birds (includes a few immatures or sub-adults together with a few non-breeders caught on the mainland) and 269 chicks were banded and flagged, yet few of these birds appeared to return in subsequent seasons. For instance, on Bird Island 2001–2004, only 8% of the breeding birds were seen to be wearing bands. Post-breeding banding and observations on mainland beaches (mainly Cape Recife at the western end of Algoa Bay) produced 9% banded birds (from 2433 adults and immatures individually checked between September 2000 and December 2004). Visitors are suspected to be coming from elsewhere (see also Tree & Klages 2003). A huge late influx of Common Terns *S. hirundo* at Riet Point and nearby localities near Port Alfred, Eastern Cape, during January 2000 was accompanied by an unseasonal concentration of Roseate Terns, peaking at more than 100 birds. The very low proportion of Common Terns wearing bands indicated that these were mainly from the poorly-studied eastern populations that migrate down the east coast of Africa and occur commonly in the Eastern Cape (Underhill *et al.* 1999, AJT unpubl. data). It is possible that Roseate Terns joined a mass southward movement of Common Terns. The Roseate Terns all appeared to be, on colouration, of the same form as those breeding in South Africa. The fact that apparent breeding took place in Mozambique and Tanzania in 2003, a year in which a substantial drop occurred in the South African population, lends support to the concept of widespread population shifts within a metapopulation. Other records of birds in nuptial dress seen during the austral summer in South Africa are documented in Tree & Klages (2003). These may relate to birds from a summer-breeding population, of which the only one known relatively close to South Africa is that of the Cargados Carajos.

There is unlikely to be much interchange between the two sub-populations of the northwestern and southwestern Indian Ocean, which remain as two recognisable forms. There could, however, be interchange between South Africa and Madagascar with occasional

breeding in Mozambique and Tanzania of birds from either of those two populations. Specimens from Tanzania in the British Museum of Natural History appear to belong to the southwestern population, with a single October specimen from Pemba Island and an undated specimen from Madagascar assignable to *S. d. arideensis*. There is also a Durban Museum specimen, collected in July in KwaZulu–Natal, South Africa, of an adult in breeding plumage assigned to *S. d. bangsi/arideensis* by Clancey (1967) and a banded bird from the Eastern Cape in November (Tree 2003b), indicating that individual dispersion may be considerable. The latter bird was a two-year old bird in worn plumage with no active moult, indicating an austral summer breeding regime. The low return rate of banded birds to Bird Island each year suggests colony interchange rather than intermittent breeding of individuals. Although two records of long-distance displacement of young birds across the Atlantic exist (Nisbet & Cabot 1995, Anon. 2002), there is no other proof of such displacement in this species. Food supply may also be a major determinant in the siting and success of breeding colonies each year in tropical populations (Milton *et al.* 1996, Ramos 2000). Disturbance by egg collectors at many sites may also be a contributing factor (e.g. Britton & Brown 1974). As in the Seychelles (Ramos 2000), food supplies at Bird Island vary from year-to-year (pers. obs.). In 2003, it was apparent that birds were not having the normal success in catching fish and that the number, quality (based on species identified and previous years observations) and size of those brought to the colony in July appeared inadequate (pers. obs.).

The possibility of substantial population shifts casts doubt upon the accuracy of regional estimates. These estimates are usually derived over a period of years by combining peak numbers for individual sites to give an overall figure, a method that would result in overestimates. It is suggested that breeding birds in South Africa and western Madagascar, and occasional breeders in Mozambique and southern Tanzania, belong to a single population; those in Kenya and Somalia, possibly together with the Seychelles, belong to the northwestern Indian Ocean population, represented by the smaller, paler *arideensis*. The birds from the austral summer-breeding population of the Cargados Carajos appear to show the characteristics of *arideensis* rather than of the intermediates of the southwestern Indian Ocean. Both long- and short-term population shifts may be a feature of the *S. d. arideensis* population.

Further banding and genetic studies, together with careful observations at all colonies to search for marked birds, are needed to establish relationships between colonies. Marking studies should be coordinated to ensure that no duplication results. It is difficult to determine population trends in an understudied region such as the Indian Ocean, especially given that birds tend to move about within the overall breeding range. Research into individual populations is therefore necessary, especially given that this species may well be declining because of the collection of eggs for food on many islands (e.g. Milon 1950, Ridley & Percy 1966, Cooper *et al.* 1984, Urban *et al.* 1986, F. Hawkins pers. comm.).

## ACKNOWLEDGEMENTS

This paper was first presented at the Waterbird Society's annual general meeting, Cuibá, Brazil, September 2003, to which I was invited by Helen Hayes and sponsored by the American Museum of Natural History. To both, I extend my gratitude. I thank Norbert Klages for creating the map of the western Indian Ocean and

Tim Dodman for allowing me to use data from the forthcoming *Waterbird Populations in Africa 3*. Thanks also to Neil Baker, Ian Nisbet, Roger Safford and Margaret Sandwith for assistance with references, and to the two referees for much useful assistance. Gregg Darling, Alf Taylor and Phil Whittington maintained observations at localities along the mainland coast that were invaluable.

## REFERENCES

- ANON. 2002. Interesting recoveries. *Ringers Bulletin* Winter 2002: 108.
- ASH, J.S. & KARANI, A.A. 1981. Roseate and Sooty Terns *Sterna dougallii* and *fuscata* breeding on islets in southern Somalia. *Scopus* 5: 22–27.
- AVERY, M. 1989. Roseate Terns. *RSPB Information* 3.
- BIRDLIFE INTERNATIONAL. 2004. Threatened birds of the world 2004. CD-ROM. Cambridge: BirdLife International.
- BRITTON, P.L. 1980. Birds of East Africa—their habitat, status and distribution. Nairobi: East Africa Natural History Society.
- BRITTON, P.L. & BROWN, L.H. 1974. The status and breeding behaviour of East African Lari. *Ostrich* 45: 63–82.
- BROOKE, R.K. 1984. South African Red Data Book—Aves. South African National Scientific Programmes Report No. 97. 213 pp.
- CLANCEY, P.A. 1965. A catalogue of birds of the South African Sub-region. Part II: Families Glareolidae–Pittidae. *Durban Museum Novitates* 7: 305–386.
- CLANCEY, P.A. 1967. The Roseate Tern *Sterna dougallii* in Natal. *Ostrich* 38: 288–289.
- COOPER, J., WILLIAMS, A.J. & BRITTON P.L. 1984. Distribution, population sizes and conservation of breeding seabirds in the Afrotropical Region. *International Council for Bird Preservation Technical Publication* 2: 403–419.
- COURTINAY-LATIMER, M. 1937. 1. Tern observations at Bird Island, Algoa Bay, C.P. *Ostrich* 8: 61–67.
- CRAWFORD, R.J.M. 1997. Roseate Tern. In: Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. (Eds). The atlas of southern African birds. Vol. 1: Non-passerines. Johannesburg: BirdLife South Africa. p. 479.
- DONNELLY, A.V. 1978. Notes from Watamu, coastal Kenya. *East African Natural History Society Bulletin* 1978: 122–125.
- FEARE, C.J. 1979. Ecological observations on African Banks, Amirantes. *Atoll Research Bulletin* 227: 1–7.
- FEARE, C.J. & GILL, E.L. 1997. The sustainable exploitation of Sooty Tern eggs in the Seychelles: Fifth Annual Report to the Division of Environment, Government of Seychelles, June 1997. 18 pp.
- FOGDEN, M.P.L. 1964. The reproductive behaviour and taxonomy of Hemprich's Gull *Larus hemprichii*. *Ibis* 106: 299–320.
- GOCHFELD, M. & BURGER, J. 1996. Family Sternidae (terns). In: Del Hoyo, J., Elliott, A. & Sargatal, J. (Eds). Handbook of birds of the world, Vol. 3. Barcelona: Lynx Edicions. pp. 624–667.
- HATCH, J.J. 2002. Arctic Tern (*Sterna paradisaea*). In: Poole, A. & Gill, F. (Eds). The birds of North America. No. 707. Philadelphia: The Birds of North America.
- ILES, D. 1994. Roseate Terns *Sterna dougallii* breeding on Zanzibar. *Scopus* 18: 48.
- KOHLER, P. & KOHLER, U. 1996. The Bazaruto Archipelago, Mozambique, a site of international importance for Palaearctic waterbirds. *Ostrich* 67: 165–167.
- LASHKO, A. 2004. Population genetic relationships in the Roseate Tern: globally, regionally and locally. PhD Thesis. Townsville, Australia: School of Tropical Environment and Geography, James Cook University.
- MILON, P. 1950. Quelques observations sur la nidification des sternes dans eaux de Madagascar. *Ibis* 92: 545–553.
- MILTON, D.A., SMITH, G.C. & BLABER, S.J.M. 1996. Variable success in breeding of the Roseate Tern *Sterna dougallii* on the northern Great Barrier Reef. *Emu* 96: 123–131.
- NEWTON, R. 1956. Bird islands of Mauritius. *Ibis* 98: 296–302.
- NEWTON, R. 1958. Ornithological notes on Mauritius and the Cargados Carajos archipelago. *Proceedings of the Royal Society of Arts and Sciences of Mauritius* Vol. II, Part 1: 39–71.
- NISBET, I.C.T. 1980. Status and trends of the Roseate Tern *Sterna dougallii* in North America and the Caribbean. US Department of the Interior, Fish and Wildlife Service, Office of Endangered Species.
- NISBET, I.C.T. & CABOT, D. 1995. Transatlantic recovery of a ringed Roseate Tern *Sterna dougallii*. *Ringing & Migration* 16: 14–15.
- NORTH, M.E.W. 1944. Notes on the sea-birds of Brava. *Journal of the East Africa and Uganda Natural History Society* 18: 32–40.
- PROJECT ZICOMA. 2001. Madagascar. In: Fishpool, L.D.C. & Evans, M.I. (Eds). Important bird areas in Africa and associated islands: priority sites for conservation. Newbury & Cambridge: Pisces Publications & BirdLife International. pp. 489–537.
- RAMOS, J.A. 2000. Characteristics of foraging habitats and chick food provisioning by tropical Roseate Terns. *Condor* 102: 795–803.
- RAMOS, J.A., MAUL, A.M., AYRTON, V., BULLOCK, I., HUNTER, J., BOWLER, J., CASTLE, G., MILETO, R. & PACHECO, C. 2002. Influence of local and large-scale weather events and timing of breeding on tropical Roseate Tern reproductive parameters. *Marine Ecology Progress Series* 243: 271–279.
- RAND, A.L. 1936. Distribution and habits of Madagascar birds. *Bulletin of the American Museum of Natural History* 72: 143–499.
- RANDALL, R.[M.] & RANDALL, B.[M.] 1978. The Roseate Tern—South Africa's rarest breeding seabird. *Quagga* 14: 22–24.
- RANDALL, R.M., RANDALL, B.M. & RALFE, M. 1991. Roseate Terns in South Africa: population size, revision of previous estimates and conservation. *Bontebok* 7: 1–6.
- RICHARDS, D.K. 1979. *Sterna dougallii*: small breeding colony on Mafia island, August 1978. East Africa Bird Report. *Scopus* 2: 273.
- RIDLEY, M.W. & PERCY, R. 1958. The exploitation of sea birds in Seychelles. *Colonial Research Studies* 25: 1–78.
- RIDLEY, M.W. & PERCY, R. 1966. Report on the exploitation of sea bird eggs in the Seychelles. Seychelles Government Printer.
- SAFFORD, N. 2001. Mauritius. In: Fishpool, L.D.C. & Evans, M.I. (Eds). Important bird areas in Africa and associated islands: priority sites for conservation. Newbury & Cambridge: Pisces Publications & BirdLife International. pp. 583–596.
- SALVAN, O. 1971. Une visite sur les îlots au sud de Tamatave (Madagascar). *Alauda* 39: 213–222.
- SKERRETT, A., BULLOCK, I. & DISLEY, T. 2001. Birds of Seychelles. London: Christopher Helm.
- TEMPLE, S.A. 1976. Observations of seabirds and shorebirds on Mauritius. *Ostrich* 47: 117–125.

- THOMAS, D.K. & ELLIOTT, H.F.I. 1973. Nesting of Roseate Tern (*Sterna dougallii*) near Dar es Salaam. *Bulletin of the British Ornithologists' Club* 93: 21–23.
- TREE, A.J. 2003a. The 2002 Roseate Tern breeding season on Bird Island. *Bee-eater* 54: 12.
- TREE, A.J. 2003b. An example of the Indian Ocean race of Roseate Tern at Port Alfred. *Bee-eater* 54: 12–13.
- TREE, A.J. & KLAGES, N.T.W. 2003. Status, biometrics and possible relationships of the South African population of Roseate Tern. *Ostrich* 74: 74–80.
- UNDERHILL, L.G. 2000. Roseate Tern. In: Barnes, K.N. (Ed). The Eskom Red Data Book on birds of South Africa, Lesotho and Swaziland. Johannesburg: BirdLife South Africa. pp. 43–45.
- UNDERHILL, L.G., TREE, A.J., OSCHADLEUS, H.D. & PARKER, V. 1999. Review of ring recoveries of waterbirds in southern Africa. Rondebosch: Avian Demography Unit, University of Cape Town.
- URBAN, E.K., FRY, C.H. & KEITH, S. (Eds). 1986. The birds of Africa. Vol. 2. London: Academic Press.
- URQUHART, C. & KLAGES, N. 1996. East to the isles. The story of the bird islands of Algoa Bay, South Africa. Bridgmeade: Bluecliff Publishing.
- VAUGHAN, J.H. 1929–1930. The birds of Zanzibar and Pemba. *Ibis* 5: 577–608, 6: 1–48.
- WATSON, G.E, ZUSI, R.L. & STORER, R.E. 1963. Preliminary field guide to the birds of the Indian Ocean. Washington, DC: Smithsonian Institution.
- WILLIAMS, A.J. & ROWLANDS, B.W. 1980. Seabirds of the Cargados Carajos shoals, July–August 1971. *Cormorant* 8: 43–48.
-