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THE MIGRATION OF BRIDLED TERNS *Sterna anaethetus* BREEDING IN WESTERN AUSTRALIA

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Bridled Terns breeding on the Western Australian coastline are generally absent from their nesting colonies and adjacent seas between early May and mid-September. The recovery of some marked terns banded at colonies in south-western Australia has now identified a definite 'wintering' area. This is located in the north-western sector of the Celebes Sea, between about 4 and 7 degrees north latitude.

Mixed flocks of adult and fledgling Bridled Terns observed moving through Lombok Strait, Lintah Strait (between Flores and Komodo Is), and via the Sabu and Banda seas in the Lesser Sundas during April-May are considered to have been Western Australian birds on their post-breeding migration. Flocks observed in Timor Sea in August, September and October are probably birds returning to their Western Australian breeding grounds.

INTRODUCTION

In Western Australia 30–40,000 pairs of Bridled Terns *Sterna anaethetus* breed on at least seventy coastal islands from Lesueur I. (13°50′S), in the north Kimberley, south to Seal Is. (34°23′S) in the south-west (R. E. Johnstone and G. M. Storr, unpubl. data).

The portion of this range south of the Houtman Abrolhos Islands has been colonized since 1900 and populations in this area continue to expand (Johnstone 1978; Dunlop and Wooller 1990; Dunlop and Jenkins 1994).

At almost all breeding colonies in Western Australia Bridled Terns arrive on their breeding grounds between late September and mid-October. The exodus, which involves the adults and the annual cohort of fledglings, usually takes place from early to mid-April. Bridled Terns are absent from the breeding islands, and from adjacent seas, between early May and mid-September (Serventy *et al.* 1971; Storr 1984; Storr *et al.* 1986; Dunlop and Jenkins 1992). A northward migration has long been postulated for Bridled Terns nesting on the Western Australian coastline, or at least for birds from the southern and mid-western colonies (Serventy *et al.* 1971). This paper reports on the results of two banding studies in south-western Australia which provide some information on the Bridled Tern migration. Observational evidence from a number of sources provides some additional detail on the pattern of movement.

STUDY AREAS AND METHODS

Bridled Terns have been banded by R. E. Johnstone (REJ) on North Fisherman Island (30°08′S, 114°57′E: Fig. 1) during 14 breeding seasons between 1971 and the present. Over that period approximately 800 birds (adults and pulli) have been banded with CSIRO/ABBBS numbered metal rings.

Banding was undertaken on Penguin Island (32°17′S, 115°41′E: Fig. 1) by J. N. Dunlop (JND) and J. Jenkins. Some initial work was done in 1983, resumed in 1986 after a four year break and continues to the present. To date 2169 Bridled Terns (1493 adults and 676 pulli or fledglings) have been banded on Penguin Island. Details of capture and marking methods are presented in Dunlop and Jenkins 1992. As with North Fisherman Island, Bridled Terns captured on Penguin Island carried a uniquely numbered CSIRO/ABBBS metal band.

When recoveries were reported from outside Australian waters, an attempt was made to contact the finders in order to retrieve as much information as possible. Finders were asked about the circumstances of the recovery and about the recovery environment. We also tried to glean any local knowledge the finders may have had about Bridled Terns in their area and about the harvesting of seabirds or the eggs.

The initial recoveries indicated that Bridled Terns from colonies in Western Australia probably moved through Lombok Strait, and other straits in the Lesser Sundas, on route to their wintering area. Both authors attempted to

Figure 1. *Map outline of Australia and the Indo-Pacific regions showing the location of the two banding stations and the region in the north-western Celebes Sea from which recoveries have been reported. Also shown is the position of the oil platforms mentioned in the text.*

observe the post-breeding migration through Lombok Straight using traverses on commercial ferries (REJ on 1 and 31 May 1988 and JND on 2 and 6 May 1993).

Details of other sea-crossings by REJ in ferries and fishing boats are as follows: Alas Strait (between Lombok and Sumbawa Is) 7 and 29 May and 18 October 1988; strait between Sumbawa and Sangeang Is 21 and 23 October 1988; seas around Sumbawa and Moyo Is 6 and 14 November 1988; strait between Timor and Semau is 22 October 1989; Flores, Solor and Lamakera Straits (between Flores, Adonara and Lembata Is) 1 November 1989; Lamakera Strait (between Lembata and Adonara Is) 12 November 1989; Flores Strait 14 November 1989; Molo Strait (between Flores and Rinca Is) 12 and 15 May 1990; seas and Lintah Strait (between Flores and Komodo Is) 17, 20 and 22 May 1990; strait between Timor and Semau Is 28 and 30 May and 20 and 25 October 1990 and 7 April 1991; Roti Strait (between Timor and Roti Is) 25 September, 5 October and 18 October 1990; Sabu Sea (between Timor and Sabu Is) 26 September and 4 October 1990; seas off SW end of Roti I. 14 October 1990; Sabu Sea and Ombai Strait (between Timor and Alor Is) 8 and 9 April 1991; Pantar Strait (between Alor and Pantar Is) 9, 16 and 19 April 1991; Alor Strait 22 April 1991; Pantar Strait and Sabu Sea 29 and 30 April 1991; strait between Timor and Semau Is and seas off SW Timor 2 and 8 May 1991; Banda Sea (between Banda and Kai Is) 30 September 1992; Banda Sea (between Kai and Aru Is) 1 and 9 October 1992; seas around Kai Is (including Nerong Strait) 12 and 20 October 1992; seas off SW Tanimbar I. and strait between Tanimbar and Selaru Is 25 and 29 April 1993 (Fig. 2).

R. Nojek provided observations from oil platforms in the Timor Sea (Jabiru Venture 11°55′33″S, 125°00′23″E) and Challis Venture (12°07′17″S, 125°00′43″E, Fig. 1).

RESULTS

Five Bridled Terns banded at the study colonies in south-western Australia have been recovered outside of Australian waters. The basic band return details from these recoveries are presented in Table 1. The recovery area is shown on Figure 1 and the specific locations are plotted on Figure 2.

Although these returns involve birds from two colonies approximately 280 kms apart, span a period of 20 years and involve adults and first year birds, the recovery locations fall within a remarkably small and defined area. This lies between about 4 and 7 degrees north latitude in the north-western sector of the Celebes Sea (Table 1, Fig. 2).

Four of the five recoveries (3 adults, 1 year 0) were from the austral winter period when Bridled Terns are known to be absent from the seas adjacent to their breeding islands. One tern in its first year of life was recovered at the southern-most locality in December (Table 1).

All three adults recovered were captured alive and in probably all these cases the terns were at sea, or at least some distance from shorelines. One bird (061–23362) was a member of a group of seven roosting at night on floating coconut shells (Adelma Calunsag, pers. comm.). Another (061–77422) alighted at night on a small fishing boat about 240 km from land (Manolito Antipolo, pers. comm.). Both of these recoveries were probably dazzled by ship lights.

The period from June to August is the fishing season for the commercial boats operating in the Celebes Sea from southern Mindanao (Adelma Calunsag, pers. comm.). This presumably corresponds to the peak season in marine productivity in the region. Bridled Terns are referred to as 'Kanaway' (Bisayal dialect) in southern Mindanao but are known only as a seasonal visitor; 'Kanaway is a mystery bird in the Philippines and you found

TABLE 1

Basic band return data for Bridled Terns marked on either North Fisherman or Penguin Island and recovered in the Indo-Pacific region.

Band No.	Colony	Date	Age	Recovery co-ordinates	Recovery date	Distance (km) /bearing
061–00170	North Fisherman	7 Jan. 1973	Year 0	3°52′N, 117°40′E	28 Dec. 1973	3540, 0°
061–21227	North Fisherman	31 Dec. 1979	Year 0	5°09′N, 119°13′E	18 Aug. 1980	3834, 0°
061–23362	Penguin Island	1 Nov. 1986	2+	6°55′N, 122°05′E	20 June 1991	4305, 12°
061–77422	Penguin Island	7 Oct. 1988	2+	4°30′N, 122°40′E	11 July 1992	4155, 12°
061–21290	North Fisherman	5 Jan. 1981	2+	5°01′N, 119°46′E	15 June 1993	3941, 8°

it at the sea' (Manolito Antipolo (sic), pers. comms.). This informant was aware of other nesting terns referring to 'some of the birds do nest on islands in the trees'. Presumably these were Black Noddies *Anous minutus*.

On 1 May 1988, REJ observed three mixed flocks of adult and juvenile Bridled Terns feeding and moving north through Lombok Strait (Johnstone *et al.* 1993). However, there was no evidence of passage movement when JND crossed the strait on 2 and 6 May 1993. Details of other observations in the Lesser Sundas by REJ are as follows:

One dead immature on Pasir I. on 20 May 1990; small flocks (up to 6) off Komodo I. on 22 May 1990; flock of 6 near Semau I. on 28 May 1990; flocks of 8, 10 and 20 between Kupang and Semau I. in September–October 1990; one just off Kera I.

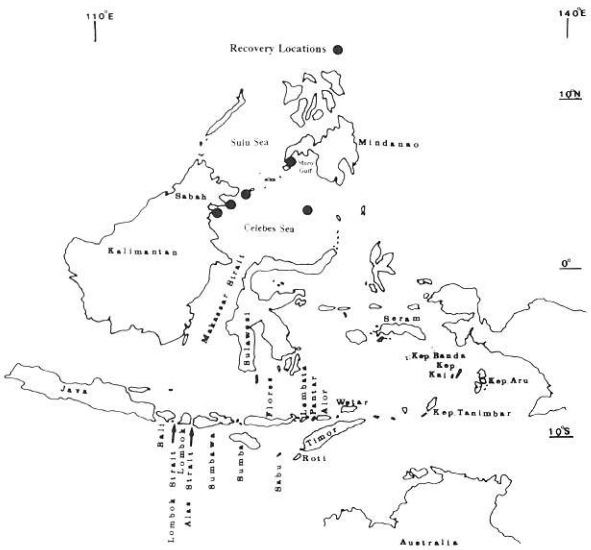

Figure 2. *Map of the Indo-Pacific Region showing the locations in the Celebes Sea at which five banded Bridled Terns were recovered* (●) and also the passages through Wallacea where these terns have been observed on migration.

on 30 April 1991; small flocks (up to 6) off Roti I. and between Roti and Ndana Is in October 1990; flocks of 50, 52 and 6 off SW Tanimbar I. on 20 April 1993; and flocks of 10, 54, 100, 20 and 15 in strait between Tanimbar and Selaru Is in late April 1993.

Details of observations by R. Nojek from oil rigs in the Timor Sea are as follows: 1–14 March 1988, 6–10 birds per day; 16–29 August 1988, 6–10 birds per day; 25 April–1 May 1989, 10–12 birds per day; 24–29 September 1989, *c.* 100 birds per day; 10–17 October, 1989, 50–100 birds per day; 12–25 January 1990, 4–6 birds per day; 18–21 April 1990, 10–30 birds per day. Adults and juveniles were observed most months.

DISCUSSION

Bridled Terns breeding at North Fisherman Island and Penguin Island during the austral summer spend the austral winter in the north-western sector of the Celebes Sea (Fig. 1).

Breeding adults and their fledglings leave their nesting colonies in Western Australia in loose flocks, usually vacating the islands by mid-April to early May, although delays have been observed in some years. Between late April and late May similar flocks were observed moving northwards through Lombok Strait, Lintah Strait and via the Sabu and Banda Seas. The fledglings with these flocks identified them with the breeding schedule in Western Australia. Breeding in the 1992/93 season was delayed in Bridled Tern colonies in south-western Australia, and as far north as the Dampier Archipelago. This may explain the absence of terns in passage in early May 1993. The northward migration appears to be a fairly leisurely movement with the terns feeding along the way. A similar post-breeding 'mass' migration has been observed on the coast of Sri Lanka near

Colombo, presumably involving Bridled Terns moving southwards from breeding colonies in the Arabian Gulf to wintering areas on the equator (De Silva 1987). Terns from the Red Sea colonies are known to move in August southwards down the east coast of Africa as far as Mozambique (Cramp 1985) in another comparable migration.

Bridled Terns from Western Australia making passage through the Lesser Sundas almost certainly complete their journey to the wintering area via Makassar Strait, presumably from the second half of May to early June. The recoveries indicate that the adults at least, are only present in the north-western Celebes Sea in June, July and August. One first year tern was recovered in the area in December which may indicate that not all birds make the return migration for their second year. Bridled Terns in this age class have been recorded at the Penguin Island and Fisherman Island colonies but they are rare. Pre-breeding birds (1–3 year olds) also appear at the Penguin Island colony later in the season than the more experienced individuals, and it is possible that the younger terns trail the adults on the return migration (Dunlop and Jenkins 1992). This may also explain the late (September/October) movements observed through the Timor Sea. The timing of arrival at the colonies would indicate that the pre-breeding migration takes place during late August to early October. Observations from the Timor Sea confirm peak passage movements in April and from late September to early October.

The circumstances of some recoveries suggest that Bridled Terns do not roost on-shore in their wintering area. This is consistent with their behaviour elsewhere (Serventy *et al.*, Cramp 1985). Flotsam is probably an important resource for roosting in the wintering habitat and this is generally plentiful in Indo-Pacific seaways. The period from June to August probably corresponds to the local peak in marine productivity, but there is little published information on this matter.

Breeding Bridled Tern populations have been recorded throughout the Indo-Pacific region (Harrison 1983) although many of these may now be in serious decline due to human interference and egg harvesting (De Korte 1991; Swaby-Stone, pers. comm; Wells 1991; REJ, pers obs.). It is not clear to what extent migrants from Western Australia occupy feeding areas used by resident breeding populations. South of Mindanao and around Moro Gulf it appears that the migrants are utilising a space in local Bridled Tern distribution. Further west, off Sabah and northern Kalimantan and south of the Sulu Islands, this may not be the case (e.g. extant colonies are recorded from Makassar Strait: De Korte 1991). There is no evidence that adult Bridled Terns are harvested and none of the recoveries to date involve birds taken for food. However, the reduction in local breeding colonies caused by egg harvesting may have favoured migratory populations by relaxing competition for food in the wintering area. Such a change could possibly contribute to the expansion of Bridled Tern populations in south-western Australia.

In Wallacea the Bridled Tern's present status in unclear, breeding is recorded on Gunung Api in July–August, probably also Sangi Sangiang (White and Bruce 1986) and from islands south of Lombok (De Korte 1991). Judging from our observations in this region there is some breeding but most birds are passage migrants to and from Australia.

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We are grateful to R. Nojek for providing Bridled Tern observations from oil platforms in the Timor Sea. Adelma Calunsag and Manolito Antipolo responded to our requests for additional information on recoveries and provided valuable local knowledge. Judy Jenkins has assisted with banding on Penguin Island since 1987.

REFERENCES

Cramp, S. (Ed.) (1985). 'Handbook of the Birds of Europe, the Middle East and North Africa.' Volume IV. Terns to Woodpeckers. (Oxford University Press: Oxford.)

De Korte, J. (1991). Status and Conservation of Indonesia's Seabird Colonies. In: 'Supplement to the Status and Conservation of the Worlds Seabirds.' (Ed. J. P. Croxall), ICBP Technical Publication, No. 11, pp. 225–247.

De Silva, R. L. (1987). Observations on the mass migration of Bridled Terns *Sterna anaethetus* off the coast of Colombo. *Ibis* **129**: 88–91.

Dunlop, J. N. and Jenkins, J. (1992). Known-age birds at a subtropical breeding colony of the Bridled Tern *(Sterna anaethetus)*: A comparison with the Sooty Tern. *Colonial Waterbirds* **15**: 75–82.

Dunlop, J. N. and Jenkins, J. (1994). Population dynamics of the Bridled Tern *Sterna anaethetus* colony on Penguin Island, south-western Australia. *Corella* **18**: 33–36.
Dunlop, J. N. and Wooller, R. D. (1990). The breeding seabirds of south-western Australia: trends in species, populations and colonies. *Corella* **14**: 107–112.
Harrison, P. (1983). 'Seabirds: An identification guide.' (Croom-Helm: Beckenham.)
Johnstone, R. E. (1978). Seabird Islands No. 64. North Fisherman Island, Western Australia. *Corella* **2**: 43–47.
Johnstone, R. E., van Balen, S. and Dekker, R. J. (1993). New bird records for the island of Lombok. *Kukila* **6**(2): 124–128.
Serventy, D. L., Serventy, V. and Warham, J. (1971). 'The Handbook of Australian Seabirds.' (A. H. and A. W. Reed: Sydney.)
Storr, G. M. (1984). Birds of the Pilbara Regions, Western Australia. Records of the Western Australian Museum. Supplement No. 16, p. 34.
Storr, G. M., Johnstone, R. E. and Griffin, P. (1986). Birds of the Houtman Abrolhos, Western Australia. Records of the Western Australian Museum. Supplement No. 24, p. 33.
Wells, D. R. (1991). Status and conservation of seabirds breeding in Malaysian waters. In: 'Supplement to the Status and Conservation of the Worlds Seabirds.' ICBP Technical Publication No. 11, 213–223.
White, C. M. N. and Bruce, M. D. (1986). The Birds of Wallacea (Sulawesi, the Moluccas and Lesser Sunda Islands, Indonesia). An annotated checklist. B.O.U. Checklist No. 7.

LITERATURE REVIEW

Compiled by D. Purchase, D. Murray and B. Baker.

This section is compiled from journals which are often not available to non-professional ornithologists in Australia. The following criteria are used to select papers for review:

- They relate to species which occur in Australia and its Territories;
- They provide details of techniques and equipment that may be of use in Australia;
- They provide details of studies that may be of general interest to Australian ornithologists.

Journals perused: *Ardea* **80**; *Auk* **108, 109, 110**; *Condor* **95**; *L'Oiseau RFO.* **61**; *Marine Ornithology* **19**; *North American Bander* **16**; *Notornis* **38, 39**; *Ostrich* **62**; *Seabird* **15**; *Wildlife Research* **20**; *Wilson Bulletin* **104**; *World Birdwatch* **13**.

GENERAL INTEREST

Recent changes in Fair Isle seabird populations. Riddiford, N. (1993). *Seabird* **15**: 60–67. (Summarizes counts of 32 years.)

Anomalous winter weather in 1984 and a seabird irruption along the coast of South Africa. Jury, M. R. (1991). *Marine Ornithology* **19**: 85–89. (An irruption of Southern Ocean seabirds associated with an unusual weather pattern.)

Failure to detect blood parasite in seabirds from the Pitcairn Islands. Pierce, M. A. and Brooke, M. de L. (1993). *Seabird* **15**: 72–74.

Possible risk of Lyme Disease from bites of ticks at seabird colonies. Duffy, D. C. (1991). *Marine Ornithology* **19**: 116. (The causal spirochaete has apparently been isolated from *Ixodes uriae;* as no cases of infection of seabird workers.) *This tick is common on Heard and Macquarie Islands and on the islands to the south of New Zealand. Editor.*

Comparison of the diet of breeding and non-breeding Cape Gannets *Morus capensis.* Berruti, A. (1991). *Ostrich* **62**: 8–12. (Regurgitations obtained from breeding gannets were heavier and contained more prey than those from non-breeders. Therefore the mean energy content of the regurgitations was significantly greater.)

Long-range movement of a Cape Gannet *Morus capensis* in the southern Indian Ocean. Berteaux, D. (1991). *Marine Ornithology* **19**: 134–135. (Fledgling banded in South Africa five years previously sited on empty nest, and in subsequent year on own nest in middle of breeding colony of Yellow-nosed Albatrosses on Amsterdam Island).

Cormorants *Phalacrocorax carbo* at cage fish farms in Argyll, western Scotland. Carrs, D. N. (1993). *Seabird* **15**: 38–44. (Brids did not take fish but attacked them through the netting causing fatal wounds.)

Diving patterns and performance in male and female Blue-eyed Cormorants *Phalacrocorax atriceps* at South Georgia. Kato, A. *et al.* (1991). *Marine Ornithology* **19**: 117–129. (The diving patterns of two males and one female were recorded with continuous-recording time-depth recorders for 10–13 days.)

Food supply and allocation of parental effort in Arctic Terns *Sterna paradisaea.* Uttley, J. D. (1992). *Ardea* **80**: (The allocation of effort between sexes during breeding changed in response to environmental conditions.)

Effect of changes in food availability on reproductive effort in Arctic Terns *Sterna paradisaea.* Monaghan, P., Uttley, J. D. and Burns, M. D. (1992). *Ardea* **80**: 71–81. (There was a significant positive relationship between the time to nest failure and adult weight at the time of hatching. It is suggested there is a critical body weight below which they abandon breeding.)

The effects of experience and age on the breeding performance of Western Gulls. Pyle, P., Spear, L. B., Sydeman, W. J. and Ainley, D. G. (1991). *Auk* **108**: 25–33. (Both factors significantly enhanced breeding success.)

Subspecific status of Least Tern populations in Texas: North American implications. Thompson, B. C., Schmidt, M. E., Calhoun, S. W., Morizot, D. C. and Slack, R. D. (1992). *Wilson Bull.* **104**: 244–262. (Demonstrates the need to be able to identify and clearly define endangered and nonendangered 'forms' of the same species.)