

FURTHER CHANGES TO THE BREEDING SEABIRDS OF LANCELIN ISLAND, WESTERN AUSTRALIA

J. N. DUNLOP and D. MITCHELL

Biological Sciences, Murdoch University, South Street, Murdoch, Western Australia 6150
PO Box 224, Lancelin, Western Australia 6044

Received: 26 June 2000

A new colony of Common Noddies *Anous stolidus* on Lancelin Island, Western Australia, increased rapidly from the nucleus of five nesting pairs first detected in January 1992. The growth in the number of breeding pairs was exponential between the 1994/95 and 1997/98 seasons, slowing to a 30 per cent increase in 1998/99. However, in 1999/00 the number of breeding pairs dropped by around 40 per cent.

Up until 1998/99 the accession of breeding pairs was effectively due to immigration. Natal recruitment by three-year old Noddies was first observed in the 1998/99 season. Most natal recruits appear to start breeding in their third year. Survival to recruitment age was estimated to be 18.5 per cent and 20 per cent for two cohorts present in the colony in 1999/00. The demographic characteristics of the Lancelin Island Noddy colony are discussed.

Sooty Terns *Sterna fuscata* were observed over Lancelin Island in the 1996/97 and 1997/98 seasons and started breeding near the Noddy colony in November 1998. The Sooty Tern colony persisted and expanded in the following season. Observed changes in the breeding seabirds of Lancelin Island are discussed in relation to the wider phenomenon of shifting tropical seabird distribution and abundance in south-western Australia.

INTRODUCTION

Lancelin Island (31°00'30"S, 115°18'55"E) is an aeolianite, continental island located 700 metres offshore from the coastal settlement of Lancelin in south-western Australia. The island is buttressed at both the northern and southern ends by eroded limestone cliffs and the core of the island is sandy and dominated by a dune ridge reaching about 17 metres above sea level. About 6.5 hectares of the island is vegetated with low woody shrubs, succulent shrubs, trailing succulents and annual forbs and grasses.

Previous records of seabirds on Lancelin island are limited but sufficient to detect significant changes in breeding species. The first authoritative records were those of V. N. Serventy who visited Lancelin Island briefly in December 1940. John Warham conducted brief studies of the Bridled Tern *Sterna anaethetus*, White-faced Storm Petrels *Pelagodroma marina* and Rock Parrots *Neophema petrophila* on the island during the 1950s (Warham 1955 and 1958; Ford 1965).

Ford (1965) conducted the first systematic survey of the fauna of the islands between Lancelin and Dongara from 1957 to 1964 inclusive. This observer made six spring and summer visits to Lancelin Island during this period to document the birds and reptiles present. At the completion of Ford's surveys the breeding seabirds documented for

Lancelin Island were the Wedge-tailed Shearwater *Puffinus pacificus*, White-faced Storm Petrel, Silver Gull *Larus novaehollandiae*, Bridled Tern, Caspian Tern *S. caspia* and Crested Tern *S. bergii*.

More recently J. N. Dunlop examined seabirds breeding on Lancelin Island during November and December 1975, October and December 1976, August-October 1977 and September 1978. During this period the first Roseate Terns *S. dougallii* were recorded breeding at Lancelin (Dunlop 1979). A record in the WA Seabird Database (Burbidge and Fuller 1996) for 28 October 1985 does not list any additional breeding species.

On 9 January 1992, Alan Burbidge reported a small colony of Common Noddies *Anous stolidus* on Lancelin Island, consisting of five nests with either eggs or young (Dunlop and Goldberg 1999). This was the first record of this species nesting south of Pelsaert Island in the Houtman Abrolhos, 275 kilometres NNW of Lancelin Island. In November 1994 a study investigating the demography of this newly established colony commenced. The results of the first three seasons of this investigation 1994/95, 1995/96 and 1996/97 have been previously reported (Dunlop and Goldberg 1999). This contribution extends the observations on the development of the Common Noddy colony to the 1997/98, 1998/99 and 1999/00 seasons and also reports on

also reports on the colonization of Lancelin Island by breeding Sooty Terns *S. fuscata*.

METHODS

In order to follow the establishment of the Common Noddy colony, Lancelin Island has been routinely visited during the breeding seasons from 1995/96 to 1999/00. The dates of field observations from 1994/95 to 1996/97 were presented in Dunlop and Goldberg (1999). In 1997/98 Lancelin Island was visited on 21 October, 2 and 15 November, 3, 9 and 20 December, 11 January, 1 and 28 February and 15 March. In the 1998/99 season the observation dates were 24 and 25 October, 13–15 and 28–30 November, 19 and 20 December, 10 and 24 January and 21 February. In 1999/00 the colony was visited on 5 and 23 September, 11 October, 4 and 26 November, 18 December, 6 and 30 January. Although these visits concentrated on collecting observations and banding operations at the Common Noddy colony, records were also maintained of the activities of all the other breeding seabird species. These records were compiled from regular traverses of the entire island.

The colony of Common Noddies was located in an area of one-metre high Nitre Bush *Nitraria billardierii* on the central western edge of the island, overlooking a reef platform and lagoon. The nests were originally all constructed on the canopy of the bushes but during the last three seasons some nests were placed on lower bushes and even on the ground. The chronology of breeding over the first three years was described in Dunlop and Goldberg (1999).

Beginning in 1995/96, a census was made of all Common Noddy nests with eggs or nest young. The count was done within four days of 29 November in all years after the 1994/95 season, when the colony was counted on 14 November. The end of November generally coincided with the earliest hatching date. During the last three seasons the colony reached a size where it became necessary to divide the area visually into sections, based on the clumping of the nest bushes, in order to avoid missing nests or double counting.

Both adult and young Common Noddies have been banded at the colony since 1995/96. Adults were generally captured with a long-handled net whilst incubating or brooding. The young were captured by hand on or near the nest and most were banded between the down and quill and fledgling stages of development. All banded Noddies carry a uniquely numbered, size 06 alloy metal band supplied by the Australian Bird and Bat Banding Scheme.

RESULTS

Common Noddy Colony

The number of pairs of Common Noddies incubating by the end of November in each season censused between 1991/92 and 1999/00 is plotted in Figure 1. The number of pairs recorded is plotted on a logarithm scale to condense a change in numbers from less than 10 to nearly 1 000 over the eight-year period. Between 1994/95 and 1997/98 the increase is linear indicating that the colony was growing exponentially. Through this period the growth must have been entirely driven by immigration as the colony could not have produced significant numbers of young of breeding age (see also Dunlop and Goldberg 1999).

The 1998/99 season produced a slowing in the accession of new breeding pairs with the colony increasing only by about 30 per cent (Fig. 1). In the 1999/00 season there was about a 40 per cent decline in the number of breeding pairs.

Five Noddies banded as chicks in the 1995/96 season were recaptured as incubating adults (3+ years) in 1998/99. However, none of 136 (1+ years) chicks banded in 1997/98 and none of the 97 (2+ years) chicks banded

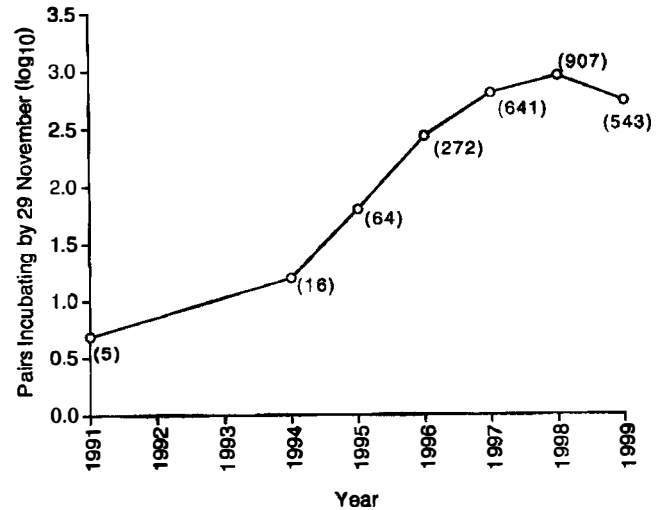


Figure 1. The logarithm₁₀ of the number of Common Noddy pairs in each observation year from the 1991/92 to the 1999/00 seasons. The number of pairs counted on eggs or chicks by 29 November in each season is shown in parentheses.

in 1996/97 were recaptured as breeding adults. In 1999/00, 11 known-aged Noddies were recaptured as breeding adults. Of these, four were four year olds (i.e. banded in 1995/96), six were three years old and one was a two year old. These recaptures indicate that the age of first breeding at the Lancelin colony was normally three years but some birds were capable of breeding in their second year.

Table 1 shows the estimated recruitment rates for known-aged birds from the 1995/96, 1996/97, 1997/98 and 1998/99 cohorts based on recaptures in the 1999/00 season. An estimate of the number of known-aged birds in the colony was obtained by determining the proportion in the 1999/00 sample of breeding adults and then extrapolating to the number of birds counted in the colony as a whole. The estimated number of recruits (by age class) in the colony was then expressed as a percentage of the number banded in the cohort.

In 1999/00 the estimated recruitment percentages for the three and four year-old Noddies breeding in the colony were similar at 18.5 and 20 per cent respectively. This suggests that the majority of natal recruits started breeding in their third year. A recruitment survival rate of around 20 per cent may be an underestimate as it was obtained

TABLE 1

The estimated percentage recruitment of known-aged Common Noddies from cohorts of chicks banded at the Lancelin Island colony in the 1995/96, 1996/97, 1997/98 and 1998/99 seasons and later recaptured as breeding adults in 1999/00.

	Banding Season			
	95/96	96/97	97/98	98/99
Number in cohort	60	97	136	193
Number of cohort captured in 1999/00 season	4	6	1	0
*Estimated number of cohort breeding in the colony during November 1999	11.8	17.8	2.9	0
Percentage recruitment of cohort in 1999/00	20.0	18.3	2.2	0

*Based on the recapture of 366 individuals (33.7%) of a total colony count of 1 086 breeding individuals.

in a year when the total number of breeding birds declined significantly.

Sooty Tern Colony

Sooty Terns were first observed in flight around Lancelin Island on 9 and 10 November 1996. These records were of occasional single birds and pairs during the day with more frequent contacts via the distinctive calls at night. However, Sooty Terns were not observed again that season over four periods of field visits from December to March.

During 1997/98 Sooty Terns were not recorded over six field visits from 21 October to 20 December. However, on 11 January, pairs of Sooty Terns were observed making passes over the island, particularly around the Noddy colony area, over much of the day. Sooty Terns were also present and behaving in much the same way on the three subsequent visits in February and March.

In 1998/99 Sooty Terns were present in flight from our first visit on 24 October and appeared to be flying closer to the surface of the island, again particularly in the vicinity of the Noddy colony. On 14 November a Sooty Tern alighted on a clump of Nitre Bush about 20 metres from the edge of the Noddy colony. On inspection four closely-spaced nests with incubating Sooty Terns were located on the ground under the Nitre bushes and two of the eggs were measured and weighed. Up to 12 birds, some apparently without nest sites, hovered over the colony area.

On 19 December one of the four eggs was pipping, giving a minimum incubation period of 35 days, considerably longer than the 26–29 days reported in the literature (Serventy *et al.* 1971; Rahn *et al.* 1984). Laying must have begun close to the time the colony was detected. On 10 January one dead and three living runners with down and quills were present in the colony area indicating that all four eggs had hatched successfully. The following day two new nests with fresh eggs were discovered in the colony area. On 24 January two fully feathered young remained under the bushes but the late eggs of 11 January had disappeared. One fledgling and an attending adult remained on 21 February.

On 4 November 1999 a group of Sooty Terns were perching on the Nitre Bush over the colony area occupied in the previous season but no birds were incubating. By 26 November seven pairs were incubating in the original area and a second group of three pairs were incubating under a separate clump of Nitre Bush about 20 metres away. Downy young were observed in the original colony area on 18 December but the second nesting group had disappeared. On 6 January, three or four feathered runners were observed under the bushes. About 10 adults were still in attendance on 30 January.

DISCUSSION

The Common Noddy colony on Lancelin Island, which began as a nucleus of five breeding pairs *circa* 1991/92, was well established by the 1998/99 season with over 900 pairs by the end of November. Colony growth was exponential between 1994/95 and 1997/98 but slowed in 1998/99 when colony size increased by about 30 per cent.

In 1999/00 the colony abruptly declined by 40 per cent reducing the colony to below its 1997/98 size.

Natal recruitment was observed for the first time in the 1998/99 season and involved Noddies in their third year. The recaptures in 1999/00 indicate that most Noddies were recruiting at this age, although one individual was recorded breeding in its second year.

Previous studies of tropical “dark” terns such as the Sooty Tern (Harrington 1974), Bridled Tern (Dunlop and Jenkins 1992 and 1994) and Common Noddy (Morris and Chardine 1995) indicate a mean age of first breeding of four or more years. Morris and Chardine (1995) suggested that there was significant delayed maturity at their generally stable Common Noddy colony in Puerto Rico and recorded ages of first breeding from three to six or more years.

The Noddies from the Lancelin Island colony has shown little, if any, delay in natal recruitment with most surviving young breeding at age three or younger. This is perhaps not unexpected in a colonizing population building towards the carrying capacity of the local marine ecosystem.

The recaptures of breeding, known-age birds in the Lancelin colony in 1999/00 indicated a rate of survival to natal recruitment of around 20 per cent. This may be an underestimate as most of the four year-old cohort would have been in the second breeding year and had incurred an additional year of losses. Further, the colony declined by 40 per cent in that year due either to increased mortality or reduced participation. If reduced participation was a factor then future estimates of survival to recruitment could be higher for these cohorts.

In 1997/98, immigration remained the major source of new pairs in the expanding Lancelin Island colony. The onset of natal recruitment in that season indicated that the colony was beginning to contribute to its own replacement. However, by 1999/00 natal recruitment alone would still have been insufficient to maintain colony size at its 1998/99 level even assuming adult survivorship as high as 90 per cent. The decline in colony size in 1999/00 could be attributed, at least in part, to a dramatic reduction in the immigration rate. If this persists one would expect colony size to stabilize well below the numbers observed in recent years.

The arrival of the Sooty Tern as a breeding species at Lancelin Island is the latest observed episode in the expansion of tropical breeding seabirds southwards into south-western Australia. This process has involved the colonization of new breeding stations by a variety of species south of the Houtman Abrolhos, progressive increases in the colony sizes at these breeding stations and the invasion of some autumn nesting populations. The species involved in these changes, at one or more localities, include the Wedge-tailed Shearwater, Red-tailed Tropicbird *Phaethon rubricauda*, Crested Tern, Roseate Tern, Bridled Tern, Common Noddy and Sooty Tern (Dunlop and Wooller 1990; Dunlop and Jenkins 1992 and 1994; Dunlop and Goldberg 1999).

The colonization of Lancelin Island by the Sooty Tern may have been facilitated by the presence of breeding

Common Noddies and Bridled Terns, both on the island and feeding offshore. Common Noddies and Sooty Terns nest in close proximity on Pelsaert Island (Storr *et al.* 1986) and the Noddies may represent part of the "habitat image" learned by Sooty Tern chicks. Inter-specific facilitation may accelerate the colonization of new breeding stations by pre-breeding terns.

ACKNOWLEDGMENTS

The authors thank the numerous people who have assisted with field work and transport to the island, but in particular Alan Baker, Wendy and Mick Payne, Jenny Goldberg, Trish Pedelty, Deborah Harding, Chris Surman, Lisa Nichollson, Julie Mitchell and Dee Margetts. The banding work was done under the auspices of the Australian Bird and Bat Banding Scheme. Permission to work on the island nature reserves was provided by the Department of Conservation and Land Management. The authors also wish to thank Chris Davey and an anonymous referee for their contribution in improving the manuscript.

REFERENCES

- Burbidge, A. A. and Fuller, P. J. (1999). The Western Australian Department of Conservation and Land Management Seabird Breeding Islands Database. In 'The Status of Australian Seabirds' (Eds. G. J. B. Ross, K. Weaver and J. C. Grieg.) Proceedings of the National Seabird Workshop, Canberra 1-2 November 1993. (Biodiversity Group, Environment Australia. Canberra.)
- Dunlop, J. N. (1979). The occurrence of breeding Roseate Terns *S. dougallii* at Lancelin Island, Western Australia. *W.A. Nat.* 14: 118-119.
- Dunlop, J. N. and Goldberg, J. A. (1999). The establishment of a new Brown Noddy *Anous stolidus* breeding colony off south-western Australia. *Emu* 99: 36-39.
- Dunlop, J. N. and Jenkins, J. (1992). Known-age birds at a sub-tropical 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.
- Ford, J. (1965). The avifauna of the islands between Lancelin and Dongara, Western Australia. *Emu* 64: 129-203.
- Harrington, B. A. (1974). Colony visitation behaviour and breeding ages of Sooty Terns (*Sterna fuscata*). *Bird Banding* 45: 115-144.
- Morris, R. D. and Chardine, J. W. (1995). Brown Noddies on Cayo Noroeste, Culebre, Puerto Rico. What happened in 1990? *Auk* 112: 326-334.
- Rahn, H., Ackerman, R. A. and Paganelli, C. V. (1984). Eggs, yolk and embryonic growth rate. In 'Seabird Energetics' (Eds. G. S. Whitton and R. Rahn.) (Plenum Press: New York) Pp. 89-112.
- Serventy, D. L., Serventy, V. and Warham, J. (1971). The handbook of Australian Seabirds. (A. H. and A. W. Reed: Sydney.)
- Surman, C. (1997). Feeding and nesting ecology of sympatric terns on Pelsaert Island, Houtman Abrolhos. PhD Thesis, Murdoch University, Perth, WA.
- 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: 29-30.
- Warham, J. (1955). The nesting of the Rock Parrot. *Emu* 55: 81-84.
- Warham, J. (1958). Photographic studies of some less familiar birds. XCI — Bridled Tern. *British Birds* 21: 303-308.