Corella, 1991, 15(4):103–107

COVERED ENTRANCES OF WEDGE-TAILED SHEARWATER BURROWS

P. K. DYER

Department of Geographical Sciences, University of Queensland, Qld 4072

Received 5 September 1990

An investigation into the association between covered burrow entrances and the breeding status of occupants of burrows was prompted when Wedge-tailed Shearwaters were seen covering the entrances to their burrows. The results showed that neither covered nor cleared entrances should be used as indicators for occupied breeding burrows. Burrows with covered entrances may contain incubating birds, and those with cleared entrances may only be used at night by immature birds. The incidence of burrows with covered entrances was related to habitat type which influenced the availability of litter and debris.

INTRODUCTION

Indicators of occupation of burrows by Wedge-tailed Shearwaters *Puffinus pacificus* have included evidence of excavation from footprints around the entrance and/or entrances cleared of debris. However, Dyer (1990) has reported an observation of a Wedge-tailed Shearwater on Heron Island covering the entrance to its burrow by reaching out with its beak to pull nearby *Pisonia grandis* leaves over the entrance. Since then, covering of burrow entrances has been seen twice, once at Point Lookout, North Stradbroke Island (27/11/1989) (Fig. 1), and again at Heron Island (3/1/1990). These birds also used their feet. One pair passed leaf litter between birds. Using its bill, a bird placed leaves near to its partner which then adjusted them over the burrow entrance with its feet. Observations of this activity in progress are few.

Warham (1990) reports that some shearwaters stuff the entrances of burrows with dead vegetation. He queries a report compiled by Montgomery in 1896 that adults do so as they leave, arguing that such burrows are often occupied. The observation at Point Lookout supports both suggestions. An adult left soon after covering the burrow entrance which, on inspection, was found to be occupied. Perhaps an exchange of incubation duties was involved. These observations suggested that burrows with covered entrances could be occupied by breeding birds.

METHODS

The study took place on Heron (23°27′S, 151°55′E) and Erskine (23°30′S, 151°46′E) Islands in the Capricorn Group, Great Barrier Reef, Queensland. Both islands are sand cays, formed by the accumulation of calcareous skeletal remains of reef organisms, within their respective reefs, and have different degrees of vegetative development (Cribb and Cribb 1985; Walker and Hulsman 1989).

On Heron Island, 12-15 December 1989, data were collected from twelve 3-metre wide transects divided into 10 m segments, systematically spaced

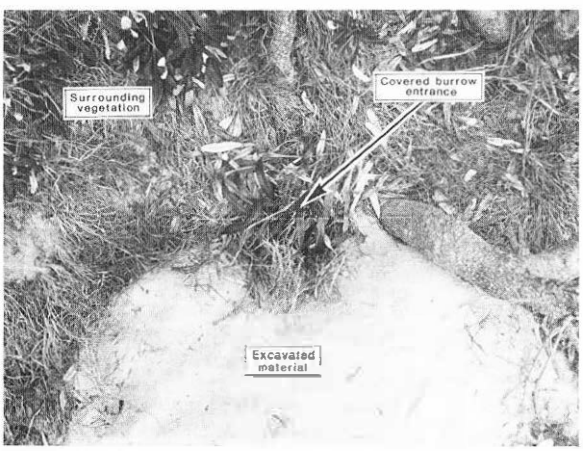

Figure 1. *A burrow entrance which has been covered by a Wedge-tailed Shearwater, at Point Lookout, North Stradbroke Island.*

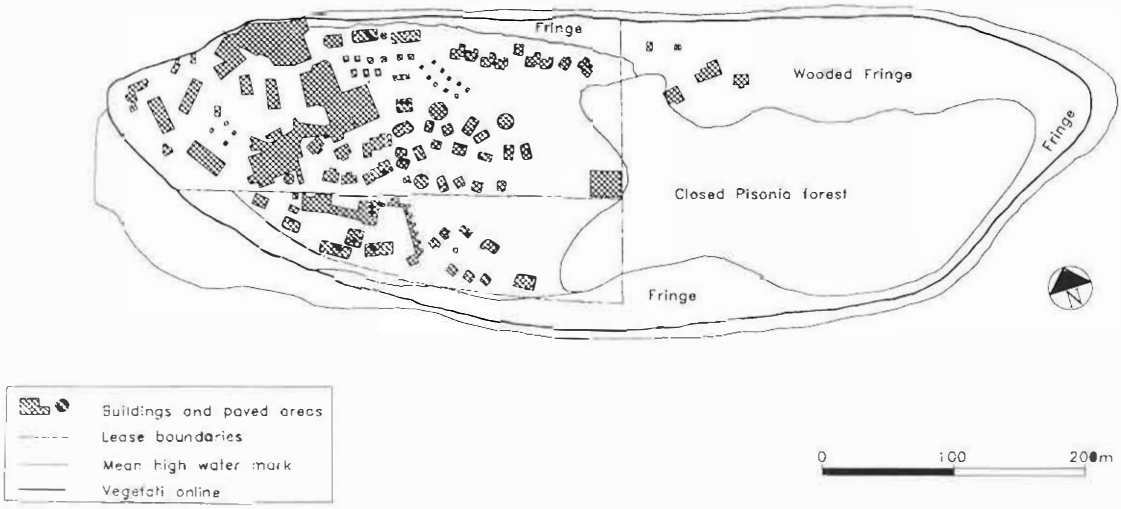

Figure 2. *Sketch map of Heron Island, showing buildings and vegetation.*

with a north/south orientation traversing the width of the island (Hill and Barnes 1989). On Erskine Island, 5 January 1990, the transects had a north-west/south-east orientation, but were divided into 5 m segments to ensure a reasonable sample size from the much smaller island.

The first Wedge-tailed Shearwater burrow encountered in each quadrat and its nearest neighbour, were inspected by means of a 'burrowscope' in order to establish burrow status. The burrowscope, which incorporates an infra-red light source to illuminate the burrow, has a miniature video camera which is inserted into the burrow. An image of burrow contents is relayed by a flexible extension cable to a monitor situated outside the burrow (Dyer and Hill 1991).

TABLE 1

Description of habitat types on Heron Island (after Dyer and Hill 1990).

Habitat	Characteristic
Pisonia bare	*Pisonia* forest with ground layer of sand and leaf litter.
Pisonia debris	*Pisonia* forest with ground layer of fallen debris.
Pisonia grass	*Pisonia* forest with ground layer of grasses.
Fringe	Grasses and shrubs, e.g. *Argusia argentea* and *Scaevola sericea*, with some *Casuarina* and *Pandanus*.
Wooded fringe	Wooded area, with a greater density of *Pandanus*, located within the more extensive north-east fringe.
Clear	Areas largely free of canopy cover.
Turf	Maintained lawns often with exotic trees or shrubs.
Buildings	Building structures incorporating paved areas and pathways etc.

The monitor image facilitates manipulation of the camera down the tunnel, which is virtually free of lining materials, to the nest chamber. If the burrow is being used for breeding purposes, the incubating bird is often seen resting on a rough mat of leaf and/or grass litter. Birds most frequently use their brood patches to incubate their single egg, but occasionally, the egg is seen situated beside the body under a wing. Thus, details of burrow contents relating to breeding activity were established.

The variables recorded were: presence or absence of entrance cover, daytime occupancy by an adult Shearwater, and presence or absence of an egg. Habitat type was recorded for each quadrat on Heron Island (Table 1), but too few observations were available for separate analyses by habitat type on Erskine Island.

The fringe habitat on Heron Island is complex and could comprise several microhabitats (Dyer and Hill 1990), particularly where more extensive with a greater density of *Pandanus* as in the wooded fringe. A separate sample from the wooded fringe (Table 1, Fig. 1) was tested; this habitat does not occur on Erskine Island.

TABLE 2

The number of burrows occupied by Wedge-tailed Shearwaters incubating an egg in various habitats on Heron and Erskine Islands. Burrow entrances are classified as having uncovered, semi-covered or covered entrances.

Island	Habitat	Total number of burrows	Uncovered		Semi-covered		Covered	
			No.	Incub.	No.	Incub.	No.	Incub.
Heron	Turf	10	8	2	2	0	0	0
	Buildings	30	19	10	7	3	4	2
	Clear	35	11	6	9	4	15	7
	Fringe	52	14	6	8	5	30	11
	P. Bare	97	38	14	32	15	27	13
	P. Debris	55	26	6	12	8	17	5
	P. Grass	26	10	6	8	4	8	3
Heron	All	305	126	50	78	39	101	41
Heron	Wooded fringe	65	13	7	30	25	22	16
Erskine	All	52	12	6	30	18	10	5

Researchers involved in analysis of turtle nesting have placed permanent identification markers at regular intervals around the periphery of the vegetation on Heron Island. From selected markers in the wooded fringe, transects such as those of the whole island study were made in a southerly direction to the *Pisonia* forest, and similar data were recorded. The data were treated separately to facilitate comparison with the fringe sample from the Heron Island study.

Data from completely (>75%) and partially (25–75%) covered entrances were pooled and tested separately and together, against those from cleared (<25%) entrances for incidence of breeding as indicated by evidence of incubation. These two chi-square analyses were to expose anomalies according to degree of entrance cover. Analyses also examined differences between the islands and the influence of habitat type. A Yate's Correction was ascertained if the results were significant but had cells with expected frequencies of <5 (Levin 1983).

RESULTS

Data from 317 burrows on Heron Island, which excluded the additional data from burrows in the wooded fringe, were compared with that from 55 burrows on Erskine Island. There was no significant difference between the occurrence of burrows with covered entrances ($\chi^2 = 0.79$, df = 1) on the two islands. Results for separate and pooled entrance cover data were similar.

On Heron Island, 127 burrows had uncovered entrances and 190 covered, and 49 per cent and 58 per cent were occupied respectively. On Erskine Island, 12 entrances were uncovered and 43 covered, with 67 per cent and 60 per cent occupied respectively. Roots or convoluted tunnels restricted the view in only a small number of burrows, so information was available to assess the association of degree of entrance cover and incubation in 305 and 52 of the burrows on Heron and Erskine Islands respectively (Table 2). There was no association using separate and pooled data on either island (Table 3).

Although covered burrow entrances were associated with habitat type (Table 3), results of analyses for the separate habitats, including the wooded fringe, were similar to those for Heron Island as a whole with one exception. There was a positive relationship between covered entrances and incubation in the *Pisonia* debris ($\chi^2 = 7.186$, df = 2, p = 0.03) where only six of 26 burrows with cleared entrances contained incubating birds. No positive relationships between entrance cover and incubation were revealed elsewhere.

TABLE 3

Results for chi square tests for relationships between entrance cover and burrow contents on Heron and Erskine Islands.

Variables	Heron Island N	χ^2	DF	p	Erskine Island N	χ^2	DF	p
			(semi-covered and covered entrances separate)					
entrance cover * habitat	317	33.508	12	0.00	55	15.369	8	0.05
entrance cover * egg	305	1.435	2	0.49	52	0.310	2	0.86
entrance cover * occupancy	317	3.707	2	0.16	55	0.757	2	0.68
entrance cover * incubation	305	2.351	2	0.31	55	4.105	2	0.13
			(semi-covered and covered entrances pooled)					
entrance cover * habitat	317	18.919	6	0.00	55	13.257	4	0.01
entrance cover * egg	305	0.172	1	0.68	52	0.003	1	0.96
entrance cover * occupancy	317	2.526	1	0.11	55	0.153	1	0.70
entrance cover * incubation	305	0.759	1	0.38	55	0.210	1	0.65

DISCUSSION

At night some apparently inexperienced Wedge-tailed Shearwaters were seen entering and leaving burrows that had clear entrances; some of these burrows were examined by different birds. At this stage in the breeding cycle experienced birds were either incubating eggs or absent, probably feeding at sea. During incubation shifts, which last from two to eight days (Amerson and Shelton 1976; Fry *et al.* 1986; Lindsey 1986), there is little or no disturbance of the burrow entrance by the breeding pair. Thus, burrows containing incubating birds could, in fact, be more likely to have covered entrances. These burrows could be covered either totally or partially by breeding birds, by falling or drifting leaf and grass litter and/or by overhanging vegetation. Birds with burrows in the fringe habitats, where most of the entrance cover consists of overhanging grasses, may exploit the characteristics of this ground cover.

However, no direct relationship was established between entrance cover and incubation for the individual islands or various habitat types, except in the *Pisonia* debris. Here, there was less incubation in burrows with clear entrances, perhaps demonstrating that inexperienced breeders prefer the *Pisonia* debris habitat where burrowing activity is greater (Hill and Barnes 1989).

Previous studies in the Capricorn Group, including Heron and Erskine Islands, have used clear entrances as indicators of breeding within the burrows (Jahnke 1975; Hulsman 1983; Hill and Barnes 1989). These burrows may be used for excavation and courtship practice by 'inexperienced' birds that visit the islands only at night. This study has shown, however, that burrows with covered entrances are being used for breeding. Clearly, on Heron and Erskine Islands, neither cleared nor covered burrow entrances indicate breeding activity, and both types of burrows have to be examined critically. These findings may well apply to colonies elsewhere.

Since covered entrances have not been shown to have a strong positive relationship with breeding burrows, covering of burrow entrances by Wedge-tailed Shearwaters may not be a common behaviour. Habitat type was shown to be associated with entrance cover on both islands. As habitat influences the availability of suitable loose materials or the presence of overhanging vegetation, it may determine whether or not entrance-covering behaviour is an option. Only further observations of this behaviour by Wedge-tailed Shearwaters, with accompanying detailed descriptions of circumstances, habitat, location, and burrow status, will clarify the reasons for, and scale of, this activity.

ACKNOWLEDGMENTS

The author appreciates the assistance of The University of Queensland Department of Geographical Sciences' Heron Island research team, especially G. Hill, and the support of The Heron Island Research Station. M. Druve, D. Gynther, and B. Dyer helped with data collection. The paper was improved on advice given by M. D. Murray and two anonymous referees.

REFERENCES

Amerson Jr., A. B. and Shelton, P. C. (1976). The natural history of Johnston Atoll, Central Pacific Ocean. *Atoll Research Bulletin* 192: 165–177.

Cribb, A. B. and Cribb, J. W. (1985). 'Plant Life of the Great Barrier Reef and Adjacent Shores.' (University of Queensland Press: St Lucia, Qld.)

Dyer, P. K. (1990). Observation of burrow covering activity by a Wedge-tailed Shearwater. *Corella* 14: 122–123.

Dyer, P. K. and Hill, G. J. E. (1990). Nearest neighbour analysis and Wedge-tailed Shearwater burrow patterns on Heron and Masthead Islands, Great Barrier Reef. *Aust. Geogr. Studies* 28: 51–61.

Dyer, P. K. and Hill, G. J. E. (1991). A solution to the problem of determining the occupancy status of Wedge-tailed Shearwater *Puffinus pacificus* burrows. *Emu* 91: 20–25.

Fry, D., Swenson, J., Addiego, L. A., Grau, C. R. and Kang, A. (1986). Reduced reproduction of Wedge-tailed Shearwaters exposed to weathered Santa-Barbara crude oil. *Arch. Environ. Contam. Tox.* 15: 453–463.

Hill, G. J. E. and Barnes, A. (1989). Census and distribution of Wedge-tailed Shearwater (*Puffinus pacificus*) burrows on Heron Island, November 1985. *Emu* 89: 135–139.

Hulsman, K. (1983). Survey of seabird colonies in the Capricornia Section of the Great Barrier Reef Marine Park, II. Population parameters and some management options. Research Report to Great Barrier Reef Marine Park Authority, Townsville.

Jahnke, B. R. (1975). Population studies of some bird species on Masthead Island, Queensland. *Qld Naturalist* 22: 132–138.

Levin, J. (1983). 'Elementary Statistics in Social Research'. (Harper and Row, New York.)

Lindsey, T. R. (1986). 'The Seabirds of Australia' (Angus and Robertson: North Ryde, NSW.)

Walker, T. A. and Hulsman, K. (1989). Seabird Islands, No. 196. Erskine Island, Great Barrier Reef, Queensland. *Corella* 13: 53–56.

Warham, J. (1990). 'The Petrels: Their Ecology and Breeding Systems' (Academic Press: London.)

Corella, 1991, 15(4): 107

BREEDING OF THE SHORT-TAILED SHEARWATER ON MUTTONBIRD ISLAND, NEW SOUTH WALES

The recorded northern breeding limit of the Short-tailed Shearwater *Puffinus tenuirostris* in Australia is Broughton Island (32°37'S, 152°19'E), New South Wales (Hindwood and D'Ombrain 1960). The species was first recorded on Muttonbird Island (30°18'S, 153°09'E) off Coffs Harbour, New South Wales (Lane 1970) in December 1969 and there have been subsequent occurrences. M. Swanson (1976) stated that 'No positive breeding record has been established but birds have been caught on the surface at night'.

During a visit to Muttonbird Island on the night of 31 October 1988 to band shearwaters, a Short-tailed Shearwater was caught on the surface and banded. A further visit on 2 November 1988 resulted in two of these birds being found in a burrow. However, subsequent checks during that season failed to reveal evidence of breeding.

On the night of 29 October 1990, prior to darkness, some burrows were checked while awaiting the arrival of the shearwaters. Each of the first two adjacent burrows searched contained two Short-tailed Shearwaters. A nearby burrow contained a single bird. About an hour later, well after darkness had fallen, I returned to the area where these birds had been found. Two Short-tailed Shearwaters were heard calling from a burrow and on checking, both were found to be unbanded. In all, three 'pairs' and a single bird had been located in burrows.

No visits were made to the island during November, as I was absent from Coffs Harbour from 10 November until 6 December. In December, two of the 'pairs' were recaptured; one bird, each on an egg, on 10 December and the other of each pair on 17 December.

However, both of these nests were empty when examined on 5 January 1991, and on two subsequent visits no *P. tenuirostris* chicks were found.

Muttonbird Island is some 270 kilometres north of Broughton Island.

REFERENCES

Hindwood, K. A. and Dombrain, A. F. (1960). Breeding of the Short-tailed Shearwater (*Puffinus tenuirostris*) and other seabirds on Broughton Island, NSW. *Emu* 60: 147–154.

Lane, S. G. (1970). Possible colonisation of Mutton Bird Island, NSW by Short-tailed Shearwaters. *Emu* 70: 141.

Swanson, N. M. (1976). Seabird Islands No. 32, Mutton Bird Island, New South Wales. *Aust. Bird Bander* 14: 88–91.

S. G. LANE

Lot 6, Fairview Road, Moonee, via Coffs Harbour, NSW 2450

Received 16 January 1991