

THE SUNBIRD



Journal of the
QUEENSLAND ORNITHOLOGICAL SOCIETY

Volume 21

Number 2

June 1991

CONTENTS

G. J. ANDERSON	The breeding biology of the Bush Thick-knee <i>Burhinus magirostris</i> and notes on its distribution in the Brisbane area	33
ANDREW M. BURTON, LILIAN G. CHAVEZ-CHAVEZ, TOM J. CADE and RENATTA CADE	A Red-footed Booby from Abergowrie State Forest, North Queensland	62
BOOK REVIEW	63

OFFICERS AND COUNCIL FOR 1991

President
ROY SONNENBURG

Vice President
GRAHAM LEACH

Post President
DAVID NILAND

Country Vice President
DAWN ALLEN

Treasurer
DON MUIR

Secretary
POLLY CUTCLIFFE

Outings Officer
JULIEN BIELEWICZ
JOHN HADLEY

Sunbird Editor
PETER BRITTON

Assistant Editor
PHILLIP MAJOR

Librarian
GRAHAM LEACH

Slide Librarian
JOHN NOYCE

Projects Officer
IAN VENABLES

Conservation Officer
SANDRA HARDING

Membership Secretary
SUE HEUSSLER

Newsletter Editor
DAWN MUIR

Council Members
PETER DRISCOLL, LYNDIA LITZ-TYNE, ANDREW THELANDER,
JEREMY THOMPSON

The objectives of the Society are to promote the scientific study and conservation of birds by all means possible, with particular reference to the birds of Queensland.

Annual subscription rates to the Society are:

Ordinary Member	\$22.00
Family Member	\$25.00
Junior Member	\$12.00
<i>Sunbird</i> subscription only	\$17.50 (Aust.)
Libraries, Universities	\$22.50 (Aust.)
Overseas	\$20.00 (U.S.)

All members receive a monthly newsletter and a copy of the quarterly journal, *The Sunbird*. The price of *The Sunbird* to non-members is \$5.00 per issue. The Society holds a general meeting and a field excursion each month.

All correspondence, including membership fees, should be addressed to the Secretary. *The Society's address is:*

P.O. Box 97, St. Lucia, Queensland, 4067.

THE SUNBIRD

Volume 21 No. 2

June 1991

THE BREEDING BIOLOGY OF THE BUSH THICK-KNEE *BURHINUS MAGNIROSTRIS* AND NOTES ON ITS DISTRIBUTION IN THE BRISBANE AREA.

G. J. ANDERSON

ABSTRACT

Detailed observations on the breeding behaviour of a pair of Bush Thick-knees *Burhinus magnirostris* were made over a period of two years in the Brisbane suburb of Herston. Six clutches of eggs were laid during this period, including four clutches in a single breeding season between August 1989 and February 1990. The incubation time was 25-26 days and the period of parental dependence of the young was approximately 60 to 70 days. Of the six clutches, chicks were hatched on five occasions and fifty percent of the chicks survived to independence. Detailed notes on the behaviour of the birds during breeding are provided. An examination of the records of *B. magnirostris* for Brisbane indicates that the species is widespread and can be considered uncommon to relatively common in the area.

INTRODUCTION

The Burhinidae or Thick-knees comprise a small group of unusual medium-sized wader-like birds with an almost cosmopolitan distribution (Hayman *et al.* 1986). The seven species of the genus *Burhinus* are all superficially similar, with heavily streaked grey or brown plumage and largely nocturnal and crepuscular habits. The biology of the group is poorly documented, and extensive information exists only for the Stone Curlew *B. oedicnemus*, a Eurasian species (Cramp & Simmons 1983). The genus is represented in Australia by a single species, *B. magnirostris*. Storr (1984) and others have used the name *B. grallarius* (for a full discussion of nomenclature see Schodde & Mason 1980).

The Bush Thick-knee is found across much of mainland Australia, but is common only in the north and northeast of the continent. Its preferred habitat is open woodland, and it is sparsely distributed to absent in very arid regions and in heavily forested areas. In the drier inland it is usually found associated with vegetation bordering watercourses (Blakers *et al.* 1984). In northern cities, where the bird remains quite common, it is often found in parks and on vacant blocks and golf courses. It breeds throughout most of its range (Blakers *et al.* 1984). While essentially confined to mainland Australia, it is particularly common on Magnetic Island (Wieneke 1988), and there are records from some Torres Strait islands (Ingram 1976) and southern New Guinea (Lindgren 1971). The Bush Thick-knee was formerly found around Sydney and Melbourne, but is now very rare or absent in these areas (Blakers *et al.* 1984). Queensland is the present stronghold of the species.

There are few data on the biology of the Bush Thick-knee. The most detailed accounts (Mathews 1913-1914, North 1913-1914, Schodde & Mason 1980) are of limited accessibility, and readily available accounts (Lane 1987, Pringle 1987) are less comprehensive. For more detailed information on the taxonomy of the Burhinidae and the biology of other species the reader is referred to other works (Meinertzhagen 1924, Schodde & Mason 1980, Cramp & Simmons 1983).

The aims of the present paper are: (1) to recount in detail observations made on a breeding pair of Bush Thick-knees in suburban Brisbane over a period of two years; (2) to draw together much of the scattered literature on the species, particularly that related to its breeding biology; and (3) to assemble records on the distribution of the species in the Brisbane area and to assess its future prospects.

METHODS

A pair of Bush Thick-knees, representing the nominate subspecies, was observed in the Victoria Park area of Brisbane (27° 28'S, 153°02'E) over a period of 29 months from January 1988 until June 1990. All but three observations were made between January 1989 and June 1990. The study area was visited on 175 occasions, and, of these, birds were observed on 153 occasions. The duration of observations varied from 2 to 30 minutes on any one visit. Most observations were less than 10 minutes duration and were made between 1200 and 1400 EST. In order to prevent undue disturbance to the birds, they were approached closely (within 20m) on few occasions. Distances less than 20m were estimated. Longer distances and areas were determined from Brisbane City Town Planning Maps.

RESULTS AND DISCUSSION

Description of Adults

The breeding pair of Bush Thick-knees studied in Victoria Park showed the markings and colouration typical of this species (Schodde & Mason 1980). The two adult birds could be distinguished from each other on the basis of the characteristics described below. These characteristics were constant over the period of observation from September 1989 to June 1990.

One bird was slightly larger (larger body as well as longer tibia) and noticeably paler than the other. Its ventral ground colouration was white and its facial markings were relatively pale, whereas the second bird showed a pale brown ground colour and dark facial markings. The paler bird had a prominent broad white 'eyebrow' whereas this stripe was narrow in the other bird. This feature was the most useful distinguishing field mark. The bill of the pale bird was relatively short and broad (dorsoventrally) and tapered from the base. The bill of the dark bird, however, was slightly longer and more delicate, and tapered only from the tip and not from the base. The pale bird was generally the more aggressive of the two.

Since egg laying was not observed, it is not possible to state with certainty which bird was the male and which was the female. In general, the male is slightly larger in this species (Schodde & Mason 1980), and has been recorded as having longer legs (Garnett 1985). In addition, in the European Stone Curlew, the male is usually the larger and paler bird of a pair (Cramp & Simmons 1983). This information suggests that the larger and paler bird of the pair being studied may be the male, but such an assignment must be treated with caution in view of the great similarity in appearance of the sexes.

Local Movements of the Birds

Bush Thick-knees have probably been resident in Victoria Park for at least 45 years. Bird lists for the area for 1945 (Filmer 1946) and 1970-74 (Watson 1976) record the species, and a pair of birds was noted in Victoria Park in 1979 (Wheeler 1979). Calls of the Bush Thick-knee have been heard regularly in Victoria Park for the last 20 years (R. Dickson pers. comm.). The persistence of Bush Thick-knees at one location for prolonged periods of time has been noted by other observers. Hindwood (1971) observed a pair, and probably the same pair, over a period of 19 years at the same site north of Sydney, and anecdotal evidence suggests longer association at some sites. For example, a pair has been reported resident at Xavier College, Indooroopilly for 30-40 years (I. Venables pers. comm.). These long periods of residence at some sites

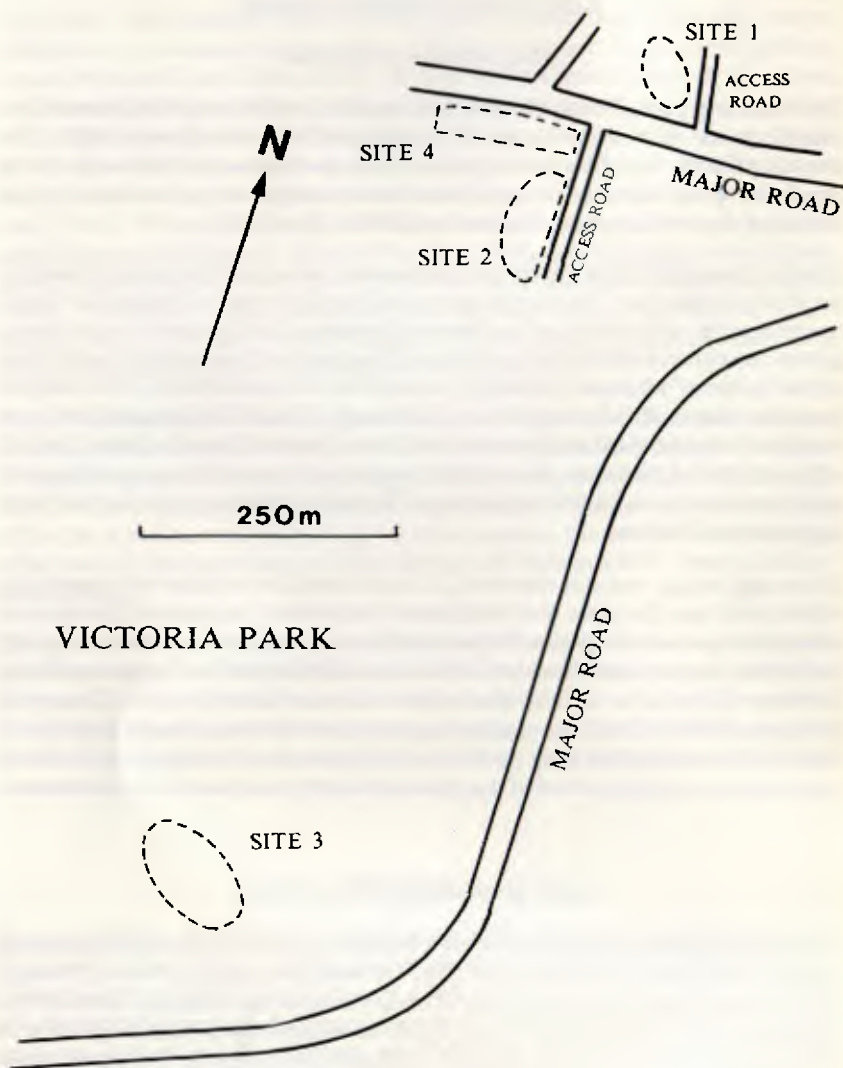


Fig. 1

Bush Thick-knee study sites in the Victoria Park area. Eggs were laid at sites 1, 2 and 3.

probably represent two or more different pairs of birds, but one bird has been reported to attain an age of at least 29 years (McGilp 1947).

The Bush Thick-knees studied occupied four major daytime resting sites (Fig. 1). Only on a few occasions were the birds found outside these areas. Three of the sites were located within an area of 1.5 ha while the fourth site was found 750m away. The birds were found within 30m of the centre of each site, and within each area there were preferred resting spots (such as particular trees, or, in one case, a park bench). Three of the sites were used for nesting. There did not appear to be any particular pattern in the use of the sites, and each would be used for a period of several days to several weeks. On a few occasions the birds would shift their site on several successive days. The tendency for pairs of Bush Thick-knees to occupy the same daytime resting site (e.g. under the same tree) for weeks at a time has been documented by several other authors (North 1913-1914, Hobbs 1961, Bedgood 1977).

The open land encompassing the nesting sites of these birds was approximately 41 ha, while the total amount of parkland associated with Victoria Park is approximately 95 ha. During the breeding season and before the young had fledged, the birds were probably restricted to the smaller area, but it is possible that outside the breeding season they foraged over the larger area or even travelled more widely in search of food. Indeed, two night visits were made to the study area (while the birds were not nesting), and on neither occasion could the birds be located despite extensive searching in a 200-300m radius from the resting site used on that day. No calls were heard. These data suggest that the birds moved well beyond their daylight resting area while feeding at night, but how far they travelled was not determined.

There are few data on the size of territories of Bush Thick-knees. Schodde & Mason (1980) found that birds in the Northern Territory occupied an area of 10-20 ha during breeding, while during the non-breeding season flocks may roam over an area of 100 km². They also noted that there are records of the species travelling up to 35 km each night to feeding areas.

Behaviour of Adults Outside Breeding Season

Non-breeding behaviour of this pair of Bush Thick-knees was observed only before and after the 1989/90 nesting season. During these periods the birds usually used the same daytime resting areas for long periods. Prior to nesting the birds were found at Sites 2 and 3, where at least two of the season's four clutches were laid. Whereas, after the last clutch was abandoned, the birds remained at Site 4 for eleven weeks before moving to Site 2 for the final seven weeks of observation. Occasionally the birds would occupy another area for

a single day during these periods.

Compared to the spectacular courtship displays of Bush Thick-knees, and their aggressive behaviour while brooding and caring for their young, their non-breeding behaviour is quiet and secretive. The birds studied usually kept close to cover, either in long grass, near shrubs, or beneath the drooping branches of small trees, but they avoided dense vegetation and selected sites which afforded them clear views in all directions. Daytime activities were restricted to sitting or standing (with occasional preening). On several overcast and/or rainy days, the birds were seen feeding in open areas close to their daytime roost, but observations suggest that feeding was otherwise done at night.

During observation the birds were always vigilant, and any approach to within 50 m caused them to 'freeze' with their heads and necks stretched forward. If approached to within 30 m, the birds would usually sit (if standing) or flatten (if sitting). Occasionally one or both birds would take a few slow steps away from the intruder. If the birds had settled they would allow an approach to within 2 - 4 m, uttering their characteristic threatening 'growl' (see below). If pressed further the birds would rise and walk away steadily, but would not run or fly.

The Bush Thick-knee relies heavily on its cryptic plumage and habits for deception, and it is generally more often heard than seen. On occasions, birds carry this behaviour to such an extent that they will allow themselves to be picked up without moving (Pringle 1987). An extreme case of this type was reported by Selby (1951) who described a bird which, when disturbed, waded into a creek and floated flat on the surface with its eyes just above the water.

In this study, none of the elaborate terrestrial (McGilp 1947, Wheeler 1967) or aerial (Bedggood 1977) courtship displays of the Bush Thick-knee described by other workers were noted, but few observations were made during the courtship period. However on one occasion (20 July 1989) before the first clutch of the season was laid, the birds were seen actively running about and calling in the early afternoon (1400 h). One bird appeared to be feeding. The call was similar to the typical drawn out 'keer-loo' of the species, but was uttered rapidly and more frequently. This was the only occasion on which this particular call was heard. The increased activity of the birds, particularly during the daylight hours, suggests that this behaviour may have been part of courtship proceedings. Indeed, Alexander (1925) noted an increased frequency of calling early in the breeding season.

Breeding Chronology

Table 1 summarizes information on the breeding of this pair of Bush Thick-knees. Evidence of six clutches was obtained during the study period (one in each of the 1987/88 and 1988/89 breeding seasons and four during the 1989/90 season). One clutch was abandoned (Clutch 6).

This pair of birds was particularly noteworthy for its frequency of repeat nesting in the full breeding season studied (1989/90). In this season, four clutches were laid, although the laying of the fourth clutch was probably precipitated by the premature loss of chicks from the third. Nevertheless, three clutches were successfully hatched during the season. Since the birds were also observed with chicks in January of 1988 and 1989, relatively late in the season, it is possible that the birds had at least one previous clutch in each of those seasons. The literature indicates that Bush Thick-knees generally breed only once a year (Beruldsen 1980), but two broods have been reported on several occasions (Garnett 1985; P. Allan, J. Wren, E. Scambler, Royal Australasian Ornithologists' Union Nest Record Scheme [RAOU NRS]). Mathews (1913-1914) states that, if the first clutch is laid early in the season and the conditions are favourable, then a second clutch may be laid.

Based on the data in the literature indicating that juvenile Bush Thick-knees usually remain with their parents for several months after hatching, and well after fledging, the period of time between successive clutches in the 1989/90 season appeared quite short. The intervals between the hatching of one clutch and the commencement of incubation of the following clutch were determined to be 39 days and approximately 46 days.

These data, along with others from the literature and the RAOU Nest Record Scheme, are collated in Table 2. In addition, should a clutch be lost prematurely, the female can produce a replacement clutch in a relatively short period of time if conditions are suitable. For example, 2-3 weeks between the loss of Clutch 5 and the laying of Clutch 6 in this study. Similar times have been reported in the RAOU Nest Record Scheme (P. Allan, J. Wren).

TABLE 1

Breeding Chronology of the Bush Thick-knees Studied
at Victoria Park, Brisbane.*

Clutch	Site	Date	Event
1	?	1.88*	2 adults with half grown chick
2	1	22.12.88	Nesting site unoccupied
		23-26.12.88	Estimated laying period
		5.1.89*	Incubation in progress
		20.1.89	Hatching (2 chicks)
		19.3.89	Adults and chicks left area
		29.6.89	Adult pair back in area
3	?	28.8.89	Birds observed. Not on eggs. No chicks present, but hatchlings may have been overlooked.
		3.10.89*	Adult pair with one chick (estimated 5 weeks old)
4	2	12.10.89	Birds observed without eggs
		13-15.10.89	Estimated laying period
		23.10.89*	Incubation in progress
5	2	8.11.89	Hatching (2 chicks)
		17.12.89*	Incubation commenced
		11.1.90	Hatching (2 chicks)
		22.1.90	Adults observed without chicks
6	3	2.2.90*	Incubation commenced
		5.2.90	Eggs found abandoned
		20-21.3.90	Adults left the area

+ Dates relevant to the the definition of incubation times and the nesting season have been included.

* Denotes the first date on which the clutch/brood was observed.

During the study period, observations encompassed only one full breeding season (1989/90), with the first clutch being laid in late August or early September and the last in early February. Such a long breeding season was a result of the multiple clutches laid during this time, and may represent an abnormal situation. The usual nesting period of the Bush Thick-knee is from August to January (Beruldsen 1980), but birds in the northwest of Australia have been reported to nest earlier (July-November) than southern birds (Schodde & Mason 1980).

The reason why Clutch 6 was abandoned is not clear, although adverse weather conditions (strong winds, heavy rain) associated with a tropical cyclone may have hindered sitting. Bush Thick-knees have been known to desert their eggs after heavy rain (Bedggood 1977), but one bird continued incubating through a violent thunderstorm (B. Newby, RAOU NRS). Around the time of the cyclone, and between the first and fourth days of incubation, the eggs of Clutch 6 were moved to a less exposed site, suggesting that the birds had been disturbed in some way. The tendency of Bush Thick-knees to leave the nest if disturbed during the early stages of incubation has been noted by several authors (Serventy & Whittell 1967, Garnett 1985), and this may have contributed to the loss of the clutch. The parent birds remained in the vicinity of the nest site for 11 weeks after abandoning their eggs (until they moved to Site 2), contrasting with the observations of Bright (1935) that birds invariably leave the nesting site if their eggs are taken.

Nesting Sites

During the period of study the Bush Thick-knees were observed incubating four clutches of eggs at three different nesting sites (Fig. 1 and Table 3). Each site was at least 5m from any cover and 2m away from any substantial object (trees in all cases). This is interesting in view of the preference of non-incubating birds for keeping close to cover during daylight hours, but it may relate to the preference for an uninterrupted view in all directions at such a vulnerable stage of the life cycle.

Bush Thick-knees appear to show considerable variation in their selection of nesting sites. While some birds tend to be wary of human intervention and will select relatively isolated or protected nesting locations, other birds will tolerate human presence. For example, birds have been recorded nesting beside a busy footpath on a university campus (Garnett 1985), beside a suburban footpath (E. Scambler, RAOU NRS), and even within 20 cm of an operational railway line in a shunting yard (J. Wren, RAOU NRS). Birds often lay their eggs next to some object such as a log, bush, or even just a tuft of grass (Bright 1935 Beruldsen 1980; RAOU NRS), but many birds, such as those described in this paper, favour open sites. Garnett (1985) has recorded birds laying their eggs directly onto mown grass, and Bright (1935) found that birds preferred to nest on short grass in open areas. Some birds will lay their eggs directly on the ground without any site preparation, whereas others will make a shallow scrape to receive the eggs (J. Wren, RAOU NRS). There is one record of a pair gathering a rough collection of sticks together (Arthur 1973).

The tendency for Bush Thick-knees to nest in the same area, if not at the same site, both within a single breeding season and in successive seasons, has been documented by several authors (North 1913-14, Bright 1935, Garnett 1985; G. Wilson, J. Wren, RAOU NRS) and was confirmed in this study. As an example, the eggs of Clutch 5 were laid within one metre of the site used for Clutch 4.

Eggs

The only eggs of this pair which were examined in detail were those of the abandoned clutch (Clutch 6). These eggs have been lodged in the collection of the Queensland Museum (registration number 0.28636). The dimensions of the two eggs were as follows: 58.9 mm x 39.0 mm, weight 41.5g; 56.1 mm x 38.5 mm, weight 42.0 g. In both size and appearance, eggs were similar to those documented elsewhere (North 1913-14, Beruldsen 1980, Schodde & Mason 1983).

Clutches examined in the present study always contained two eggs, which is the usual clutch size (Beruldsen 1980). The eggs are laid with a two-day interval and incubation is commenced with the laying of the second egg (Bright 1935, Garnett 1985). Single egg clutches have been reported (MacGillivray 1923, Bright 1935, Storr 1984, RAOU NRS), and exceptional clutches of three or even four eggs have been recorded (McGill 1947, Arthur 1973, Bedgood 1977). On rare occasions a single nest has been found containing four eggs, which appeared to be two pairs of eggs from two different females (North 1913-14, Lashmar 1937).

Behaviour of Incubating Bird

The undisturbed incubating bird adopted an alert, erect posture with its head raised. If approached closely (<10 m), the bird would 'stiffen' and flatten its body, sometimes with the head and neck pressed against the ground, but usually held at an angle of 10 - 15 degrees to the ground. Sometimes the flattening was preceded by a particularly erect posture, perhaps a type of threat or warning display, in which the head was well raised and the tail partially cocked, but not fanned. If the bird was approached very closely (<2 m), it remained still but gave a throaty 'growl' (see section on Vocalizations). If an attempt was made to physically move the bird from the eggs, the intensity and frequency of 'growling' increased substantially, and the intruder was presented with an impressive mantling display. For this display the bird adopted a low crouch over the eggs with both wings outstretched and drooping

on the ground. The tail was fully fanned, but not erect. The mantling display was observed on two occasions. On one other occasion, the sitting bird allowed its breast feathers to be parted to reveal the eggs. No mantling display was given, though intense 'growling' was encountered. At no stage did the sitting bird attempt to peck the intruder.

This pair of Bush Thick-knees was somewhat unusual in that the eggs were protected with great resolve from the commencement of incubation (although defence became even more vigorous as incubation progressed). Early in the incubation most defence was carried out by the sitting bird alone, yet this bird would never leave the nest unless physically forced to do so. Closer to hatching, the non-incubating bird became the aggressor, allowing the incubating bird to remain on the eggs.

A variety of responses of incubating Bush Thick-knees to the approach of an intruder or predator have been recorded in the literature, but defence of the eggs is usually more vigorous in the latter stages of incubation. During early incubation some birds will quietly steal away from the nest while an intruder is still some distance off (North 1913-14, Bright 1935, McGilp 1947, Serventy & Whittell 1967), presumably to conceal the location of the eggs. Bright (1935) proposed a similar explanation for his observation that birds disturbed while nesting rarely flew. This secretive behaviour may explain why Arthur (1973) frequently found the eggs unattended when the nest of a pair of birds under study was examined. Some birds will leave the nest in the early stages of incubation, but will confront an intruder rather than move away (Garnett 1985; J. Wren, RAOU NRS).

In the latter stages of incubation, Bush Thick-knees are reluctant to leave the nest (Garnett 1985), although some very wary birds have been reported to do so and move away quietly (Bright 1935; R. Mason, RAOU NRS). Those birds which do not, at least at first, leave the nest, flatten against the ground in an attempt to conceal themselves (Alexander 1925; J. Wren, RAOU NRS). If the bird is discovered on the nest and is induced to leave and face an intruder, then it usually gives the characteristic spread-wing threat display (see following section) (Cleland 1906, MacGillivray 1923, RAOU NRS).

Behaviour of Non-Incubating Bird

During incubation, the non-sitting bird in this study remained at a distance of 10-40 m from the nest. In general the non-incubating bird was more distant from the nest during early incubation, and attended the sitting bird more closely during the latter stages of incubation. If the sitting bird was approached more closely during the first two weeks of incubation, the other parent would

generally look on attentively but would not move closer to the nest. If the second parent was close to the incubating bird at the time of the intrusion, then it would defend the nest and sitting bird vigorously with much 'growling' and a typical threat display involving outstretched wings and cocked tail. However, this only occurred if a very close approach to the nest was made (<2 m). As hatching approached, there was a noticeable increase in the intensity of nest defence by both parents, although the incubating bird remained on the eggs. In the final 7-10 days before hatching, any approach to the nest within 5 m was met with aggressive threatening behaviour by the non-incubating bird. These observations confirm those made in other studies. Most workers have found that during incubation the non-sitting bird remains fairly close to its mate (Schodde & Mason 1980, RAOU NRS), although Arthur (1973) reported that the non-incubating bird of a pair she was studying remained 400-1600 m from the nest.

The threat display of the Bush Thick-knees under observation was quite spectacular. The wings were spread and drooping, while the tail was fanned and cocked. On several occasions a bird rushed at the observer, approaching very close (within 0.5 m) but making no attempt to peck. Following the retreat of the observer, the bird would usually place itself between the nest and the intruder, and remain near the sitting bird until the putative danger passed. The threat display observed was similar to that described by other workers (Arthur 1973; J. Wren, RAOU NRS) and illustrated by McGillivray (1923) and Pringle (1987).

Nest Relief

This study confirmed the observations of previous workers that Bush Thick-knees generally share incubation of the eggs (Cleland 1906, McGilp 1947, Serventy & Whittell 1967, Schodde & Mason 1980, Garnett 1985; E. Scambler, RAOU NRS). However a possible case of single parent incubation has been described (Arthur 1973), and in another pair the eggs often appeared to be left unattended (E. Scambler, RAOU NRS). The time spent incubating by each parent and the length of each sitting could not be determined from this study and do not appear to have been described. However, observations on Clutch 2 were able to provide some information on the procedure of nest relief.

Relief of the sitting bird was observed during the incubation of Clutch 2 at 1330 h on 9 January 1989. The incubating bird was sitting in the usual position with head raised. The non-sitting bird, which had been standing 8-10 m away, approached the nest, walking slowly with head and neck partially lowered and outstretched, and stopped about 5 m away. The sitting bird immediately rose, and slowly walked away at an angle of about 90 degrees to

that of the approaching bird. At a distance of 5 m from the nest, this bird also stopped. The incoming bird then walked slowly to the nest and settled on the eggs, while the outgoing bird stayed about 5 m away for the duration of the observations. The whole process was completed in 60 - 90 seconds, and appeared orchestrated so as to bring as little attention to the actual nesting site as possible.

Incubation Time and Hatching

The most reliable data from the present study indicated an incubation time for the Bush Thick-knee of about 25 days. Data from these birds and other data taken from the literature are summarized in Table 2. The most precisely determined incubation time for this species is the 23 days recorded by Garnett (1985). Data from the RAOU Nest Record Scheme are less precise, but in one instance incubation lasted for at least 29 days (J. Wren). Thus, existing data suggest a range of incubation times from 23 to 30 days. Several other congeners have incubation periods from 24 to 26 days (Cramp & Simmons 1983, Maclean 1985). Although further observations are required, these data suggest that the Bush Thick-knee has a similar incubation time to that of other *Burhinus* species.

Although the hatching of any clutch was not actually observed, the presence of dry chicks between 0900 and 1300 h on the day of hatching suggested that hatching occurred during the previous night or early that morning. In each case where observations were made around the time of hatching, both eggs hatched successfully, and did so on the same day (or night). Synchronous hatching has been reported by most other workers, including the synchronous hatching of three eggs in one case (Arthur 1973, Schodde & Mason 1980, RAOU NRS). However, several cases of asynchronous hatching, with a one day interval, have been reported for the Bush Thick-knee (Alexander 1925; L. Gibson, R. Mason, RAOU NRS), and asynchronous hatching has been observed in the European Stone Curlew (Cramp & Simmons 1983). The Bush Thick-knees appeared to remove the egg shells soon after the eggs had hatched, as on no occasion were any shells found on or within a 10 m radius of the nest on the day of hatching. Egg shell removal has been noted for this species by J. Wieneke (RAOU NRS).

Parental Care of Young

The adult Bush Thick-knees defended their young vigorously, particularly in the first week after hatching. Chicks less than 24 hours old were most vulnerable as they were still unsteady on their legs. They were very closely attended by their parents. Indeed, detailed observations on Clutches 2 and 4 indicated that chicks up to the age of 15-20 days were rarely more than one metre from one of their parents (except when left in hiding at the approach of an intruder - see below). Defence of the chicks usually involved one parent confronting or running at the intruder, giving the characteristic spread-wing threat display (see above), while the other parent remained with the chicks. Similar vigorous defence of the chicks has been recorded by other observers (MacGillivray 1923, McGilp 1947, RAOU NRS).

In the first three days after hatching the chicks were often brooded beneath the wings of the adult. Indeed, for Clutch 5, the chicks were not actually seen on the day of hatching despite two visits to the area (presumably hidden by the plumage of brooding parents). Chicks would seek shelter under the wings of a parent bird up to the age of about 2 weeks. Beyond that age they were too large to do so effectively. For example, on one occasion two 19 day old chicks sought shelter beneath the wings of a parent as it started to rain (young chicks were always sheltered by the parents during rain). Although the parent obliged as much as possible, it appeared neither comfortable for the adult nor effective for the chicks, as little more than their heads and necks were protected.

As was the case with incubation, the care of the young chicks was shared by both parents, although the larger, lighter-coloured bird appeared to take a greater share of these duties. In the first three weeks after hatching, and when the parents were examined in sufficient detail to be distinguished from each other, the lighter-coloured (larger) bird was observed attending the chicks eight times and the darker bird twice. Nevertheless, the other adult was always close by and assisted in the defence and feeding of the young. Frequently (40-50% of the time) the chicks were attended by both parents.

The young Bush Thick-knees were quite mobile from or soon after hatching, and within the first week the family appeared to move progressively further from the nesting site. The following distances from the nest were recorded for families with chicks of varying age: day of hatching - 30m (Clutch 2), 25m (Clutch 5); 2 days old - 100m (Clutch 2), 70m (Clutch 4); 4 - 6 days old - at least 200 - 300m (Clutches 4 and 5). It is possible that the very young birds may have been moved away from the nest under the wings of the parents (see below), but they appeared quite capable of travelling distances of 25 - 30m by themselves. Certainly by the time the birds were four days old they were running strongly and could move relatively large distances with ease. Other workers have

reported Bush Thick-knees moving considerable distances from the nest-site within 2 to 3 days of hatching (Arthur 1973; S. Garnett, RAOU NRS).

On several occasions when the family was approached and the chicks were less than 1 week old, the adults would move off slowly, leaving one or both chicks crouched close to the ground. However, the parents were very watchful and did not move more than 5m from the young. On one occasion when the parents began to move off, a crouching chick rose as if to follow, but immediately returned to ground, appearing to respond to a parental signal (though none was heard or seen). If a chick which had been left by its parents was approached, one or both adults would rapidly come to its defence with the typical threat display described above for the non-incubating bird. Chicks older than a week were very mobile and were led off by the parents if approached. However, G. Wilson (RAOU NRS) has observed similar crouching behaviour in chicks three to four weeks old.

The behaviour of the Thick-knee chicks in lying motionless against the ground appears to be instinctive (MacGillivray 1923, McGilp 1947), and has been observed in orphaned chicks (Burrell 1909). Nevertheless, as noted above, the young may also adopt this position in response to some signal from the parent. For example, J. Wren (RAOU NRS) has recorded chicks dropping to ground immediately when one of the parents gave the characteristic 'wee-loo' call. After the danger has passed, the chicks rejoin their parents. In the present study, one of the adults called up the chicks with a short, low whistle; however, Bedggood (1977) suggested that the signal may be a particular posture of one of the parent birds (head bobbing or ruffling of the feathers) and not an audible call.

Few observations on the feeding of the chicks were made. When the chicks were very young (less than one week old), one parent was often seen foraging in full daylight up to 30m from the rest of the family. Since this behaviour was not observed after the chicks were about seven days old, it is possible that the foraging adult was gathering food for the chicks. The presentation of food to the chick was seen only once, when the chicks were less than 24 hours old. One adult had moved approximately 20m away from the other parent and chicks and had gathered a food item. It then returned to the other birds and was met by one of the chicks approximately 1 - 1.5m from the others. The food item was dropped in front of the chick who then ate it. No other feeding of young chicks was observed, presumably because most feeding was done at night. On several occasions older chicks were seen pecking items off the ground or off grass stems. Adult Bush Thick-knees have been recorded presenting food to their chicks for at least 50 days after hatching (i.e. past fledging) (E. Scambler, RAOU NRS).

Development of Young

The newly hatched Bush Thick-knee chicks were covered with thick pale grey down and boldly marked with three pairs of dark brown to black stripes (see Schodde & Mason (1980) for a more detailed description). This plumage showed few changes in the first two weeks, but on day 18 the first adult feathers began to appear on the face and wings, and by the 25th day the plumage was predominately adult, although some down remained. At this age the juveniles were about half the size of their parents. By the time they were three quarters adult size (day 33), only vestiges of down remained and the tail was not fully developed. By the 46th day the young had their full teleoptile plumage, but they were still noticeably smaller than their parents.

These changes in the juvenile plumage are very similar to those described by Schodde & Mason (1980) and Mathews (1913-1914). Schodde & Mason (1980) state that birds moult from down directly into their flying plumage, and by day 40 the flying plumage is complete. The birds are presumably fledged soon after this. Garnett (1985) noted that it was difficult to determine exactly when the young birds of the human-tolerant family he was studying were capable of flight, since they never took to the air, even when pressed. Data relating to the fledging of the Bush Thick-knee and several other Thick-knee species are summarized in Table 2. The fledging time given for *B. oedicephalus* (36-42 days) (Cramp & Simmons 1983) is similar to that for the Bush Thick-knee, whereas that of *B. capensis* (South Africa) is somewhat longer (49-56 days) (Maclean 1985). Although the precocial young of the Bush Thick-knee were mobile soon after hatching, they were very dependent on their parents to recognize danger and take appropriate action. This was true not only of very young chicks, but also of much older chicks up to and even beyond fledging. For example, 5-6 week old juveniles were not very wary and would move off at the approach of an intruder only if led by the parents. Following the hatching of a new clutch, the surviving young of the previous clutch were reluctant to leave their parents even though they had been chased away. These 'orphaned' birds seemed unsure of their situation and were on several occasions found to show exaggerated cryptic behaviour by lying prostrate along the ground for hours. The parents only adopted this posture in response to the approach of an intruder, and generally, even if sitting, would keep an observant head raised.

The multiple clutches of the 1989-90 nesting season provided an opportunity to study the behaviour of the parents towards the fledged young of their previous brood and to assess the response of the young birds. The first signs of antagonism by the parents towards their young from the previous brood came with the laying of the new clutch. During the two days of laying of Clutch 5, the remaining bird of the previous clutch was found sitting 40m away from

its parents. After incubation commenced, the fledged chick was again found with its parents, and remained within a few metres of the non-incubating bird. Several days prior to hatching the parents became very aggressive, and the juvenile from the previous clutch was again forced to a distance of about 40m from the incubating bird. Following hatching, the young from the previous brood were only once seen within the same general area as the parents (a youngbird from Clutch 3 was 150m away from Clutch 4). Fledged young were seldom located within 200-300m from the parents. The surviving young from Clutch 4 were not recorded in the area after Clutch 5 hatched; however, when Clutch 4 moved out of their nesting area a few days after hatching, a single mature bird, presumably the remaining chick of Clutch 3, appeared in the area. This bird remained in its old territory for 3-6 days, but disappeared again when its parents and their Clutch 4 chicks returned. In summary, whenever the young from the previous brood is perceived as a potential threat to the new clutch (during laying, late in incubation, or after hatching), it is chased out of the immediate vicinity by its parents.

In his study of consecutive clutches of the Bush Thick-knee, Garnett (1985) recorded the surviving young from the first clutch being chased by both parents shortly before the first egg of the second clutch was laid, but it soon returned and remained close to the male parent during laying. E. Scambler (RAOU NRS) also recorded Bush Thick-knees chasing their 49 day old juvenile. In this instance a second clutch was laid 1 - 2 weeks later, and by this time the juvenile from the previous brood was not to be found in the area. Each of these cases involved young from the first of two clutches in the one breeding season. Scambler has reported that the young from the last clutch of the season left the group after fledging, but that in this case it did not appear to be attacked.

Breeding Success and Fate of Chicks

During the study period, five chicks survived long enough to become independent of their parents. If one assumes that each brood consisted of two eggs, then breeding success (i.e. number of young raised/number of eggs laid) over the six clutches was 42%. If both eggs of each brood were hatched then the survival rate of chicks in the five successful broods was 50%. For two of the broods, only single chicks of relatively advanced age were observed, so it was not possible to determine whether two chicks were hatched or only one. McGilp (1947), in a study in South Australia, reported that, on average, only one chick survived per breeding season over a period of 12-14 years. If one two-egg clutch had been laid each season, then the breeding success would have been about 50% and somewhat lower if multiple clutches were laid. Schodde & Mason (1980) note that infertility is high in the Bush Thick-knee and frequently only one egg hatches.

Of the three clutches which were followed from hatching (or soon after hatching) to adulthood, only once were both chicks raised. On the second occasion one chick was lost between 6 and 13 days after hatching. All four birds had moved away from the nesting area during this time and were not available for observation, so the exact age at which the chick went missing could not be determined. On the third occasion both chicks were lost between 2 and 7 days of age (Table 2).

The loss of chicks in the study area was probably due to predation by cats, or possibly dogs. The busy suburban roads in the area may result in casualties due to collisions with vehicles, but for the two cases described above, no dead birds could be found on adjacent roads. Very young birds (less than 3 days old) attracted the close attention of Pied Butcherbirds *Cracticus nigrogularis*, and to a lesser extent Torresian Crows *Corvus orru*, but both species are only likely to take unattended chicks. The period for which the juvenile birds associated with the parents was remarkably constant, both between consecutive clutches and for the last clutch of the 1988-89 breeding season (Table 2). In general, however, the periods of parental care between consecutive clutches are shorter than those associated with the last clutch of the season or single clutches (Table 2).

TABLE 2

Selected Breeding Parameters of *Burhinus magnirostris* and Comparative Data from Some Other Species.

Parameter and Species	Duration+ (days)	Reference
Incubation Time		
<i>B. magnirostris</i>	25	This study
	25-28	This study
	24-26	This study
	23	Garnett (1985)
	21-27	E. Scambler
	>23	J. Wren
	>25	J. Wren
>29	J. Wren	
<i>B. oediconemus</i>	24-27	Cramp & Simmons (1983)
<i>B. vermiculatus</i>	24	Macleay (1985)
<i>B. capensis</i>	24	Macleay (1985)
Period of Parental Care		
<i>B. magnirostris</i>	>59	This study
	61*	This study
	approx 70	This study
	53-71	Garnett (1985)

	>138	Garnett (1985)
	59-64*	E. Scambler
	97-101	E. Scambler
	90-106	J. Wren
	>101	J. Wren
Fledging		
<i>B. magnirostris</i>	47-50	Schodde & Mason (1980)
	<59	E. Scambler
<i>B. oediconemus</i>	36-42	Cramp & Simmons (1983)
Age of Chicks When Lost		
<i>B. magnirostris</i>	6-13	This study
	25	This study
	<21	P. Allan
	14	M. Crouther
	1	J. Wren
	6-7	J. Wren
Multiple Clutch Intervals (same breeding season)		
<i>B. magnirostris</i>		
Laying Clutch A/Laying Clutch B		
	63-65	This study
	47#	This study
	approx 103	E. Scambler
	approx 134	J. Wren
	46-51#	J. Wren
Hatching Clutch A/ Laying Clutch B		
	22#	This study
	39	This study
	approx 46	This study
	51	Garnett (1985)
	<22#	P. Allan
	76-81	E. Scambler
	90-106	J. Wren
	21-26#	J. Wren

+ For *B. magnirostris* data are presented as ranges if daily observations were not maintained, or as maximum (<) or minimum (>) times. Values labelled as 'approx.' were calculated using an estimated incubation time. Unpublished data are from the RAOU Nest Record Scheme. For other species, means or mean ranges are given.

* Between consecutive clutches in one breeding season.

Premature loss of chicks.

Vocalizations

The characteristic call of the Bush Thick-knee is an eerie whistle, often described as 'wee-loo' or 'ker-loo', which is usually given at night. During the day the birds generally remain silent, but frequent daytime calling has been noted on occasions, particularly early in the breeding season (Alexander 1925). For the pair of birds in the present study, the characteristic 'wee-loo' was heard only once during the study period, and that was during daylight in the period preceding nesting. On this occasion the call was uttered three or four times in quick succession, and this series of calls was repeated several times over a 5 minute period. The vigorous nature of these calls suggests that they may have been part of courtship proceedings. The most common vocalization of the birds studied was a throaty growl, used predominantly in the defence of the nest and chicks. This noise, which has been noted by others (Bright 1935; J. Wren, RAOU NRS), was uttered by both birds. The European Stone Curlew, when defending its nest or young, has been recorded as both hissing loudly and making a variety of hoarse sounds (Cramp & Simmons 1983).

Most observations were made from a distance, so little could be learned of the softer contact calls. However, on two occasions, when the birds had young chicks, calls were noted. The first was a short, low whistle given by one of the parents as a summons call when the chicks were 10 days old. The chicks had flattened themselves on the ground when the family was approached by an intruder, and the parents had moved a few metres away from their young (see Parental Care above). If the observer continued to approach the chicks, one parent gave the whistle and the young immediately rose and ran to their parents. A chick summons call of this type has been recorded for the European Stone Curlew (Cramp & Simmons 1983). The other call was a soft clucking which one parent used while leading 15 day old chicks away from an approaching observer. Although this call, like the whistle, was also a request for the chicks to follow, in this case they were not being called up from a cryptic position. J. Wren (RAOU NRS) has recorded clucking by the parents being used to call crouching chicks away from potential danger. Clucking has also been recorded by a bird during the preparation of the nest-site (Cleland 1906). Chicks and juvenile birds are generally silent. A 22 day old chick was heard to give a low, short peep, but otherwise no calls were noted.

TABLE 3

Details of Nesting Sites

Site	Area Description	Site Description
1	Parkland consisting of mown grass and numerous large eucalypts. Nest 2m from base of large tree, 20m from heavily trafficked access road, 40m from major suburban road.	Grass cover 70%. Sparse cover of dead leaves and twigs. Nest on bare soil, cleared but no scrape. Dappled sunlight most of day.
2	Unused section of golf course. Mown grass with scattered small and large trees. Nest 5m from nearest tree, 15m from moderately trafficked access road.	Grass cover 95%. Eggs laid on grass. In direct sunlight 3-5 h each day, otherwise dappled sunlight.
3*	Between two fairways on golf course, but kept mown. Many small and large trees. Nest 5m from nearest tree. Light pedestrian traffic 20-40m either side of nest.	Grass cover 30-40%. Eggs laid on bare ground amongst small stones. No scrape. Full sunlight 3-4 h each day.

* After incubation had commenced, the eggs were moved 5m to a more protected site with heavy leaf litter cover, beneath a sapling at the base of a large tree. The moved eggs did not appear to be incubated further.

Movement of Chicks and Eggs by Parents

The Bush Thick-knees studied were twice observed carrying chicks under the wing. On one occasion, when the parent birds were approached three days after their chicks had hatched, one bird stood to reveal a small pair of legs protruding from beneath one wing. After taking a few steps the bird dropped the chick, which immediately flattened on the ground. On the other occasion, with a different clutch, a similar scenario was observed, but in this case the chick was carried 5m before being dropped next to the other parent. Again the young bird flattened immediately. These observations confirmed the capacity of the adult birds to carry chicks beneath their wings, as documented elsewhere (Zietz 1917; J. Wren, RAOU NRS); but they do not provide evidence that birds are carried deliberately. Since chicks in the first 7-10 days of their lives spend considerable time sheltering beneath their parents' wings, the observations made could be explained on the basis of the parent drawing the chicks closer to the body at the approach of an intruder, rather than them

being lifted and carried off with any intent. Since the precocial young can move readily from the time of hatching, most of their movement is probably made without parental assistance. In times of danger it is possible that wing-carrying is used as a means of locomotion. The eggs of the abandoned clutch (Clutch 6) were moved about 5m between the first and fourth days of incubation, but the operation was not observed. Over such a short distance, it is possible that the eggs were rolled by the parents, but alternatively they may have been carried, either in the beak or beneath the wings. There are a number of documented reports of Bush Thick-knees moving their eggs much longer distances (Bright 1935; K. Milne, R. Sympton, RAOU NRS), including one instance of eggs being moved 450m (Arthur 1973), so rolling would be impractical. In no case, however, was the mode of egg movement determined.

Interspecific Interactions

The birds studied remained quiet and inconspicuous throughout the daylight hours and showed few interactions with other species. A prominent exception to this was the interest shown in newly hatched birds by Pied Butcherbirds and Torresian Crows as noted above. The various sites occupied by this pair fell within the territories of both Noisy Miners *Manorina melanocephala* and Australian Magpies *Gymnorhina tibicen*, but neither species showed any interest in the birds. However, other workers have observed Magpies harassing Bush Thick-knees, both while on the nest (Bright 1935), and after the chicks have hatched (Bedggood 1977). The Willie Wagtail *Rhipidura leucophrys* and Blue-winged Kookaburra *Dacelo leachii* have also been recorded attacking birds on the nest (Arthur 1973; E. Scambler, RAOU NRS), but with little apparent reprisal. Nevertheless, there is some evidence that Bush Thick-knees will defend their territories, as a bird has been recorded chasing a Pheasant Coucal *Centropus phasianinus* which wandered into its territory (E. Scambler, RAOU NRS).

One of the birds most likely to be encountered by nesting Bush Thick-knees is the Masked Lapwing *Vanellus miles*, and at Sites 2, 3 and 4 the daytime roosts adjoined the territories of a pair of Masked Lapwings. These aggressive birds did not usually forage in the area occupied by the Thick-knees except for three days at Site 4 after the completion of the breeding season. The Lapwings on each occasion were observed foraging only 25-30m from the Thick-knees, and were not being aggressive toward them. On several occasions Masked Lapwings occupying a territory 200-300m from Site 2 moved onto that site when the Thick-knees left the area. However, when the Bush Thick-knees returned, the Lapwings immediately left and reoccupied their former territory. Bedggood (1977) records somewhat more aggressive behaviour of the Masked Lapwing when a pair of Bush Thick-knees was protecting recently hatched young.

ACKNOWLEDGEMENTS

The author would like to express his gratitude to the following people who assisted in various ways during the writing of this paper. Wayne Longmore of the Queensland Museum kindly provided Museum data on the Bush Thick-knee in the Brisbane area, provided the measurements of the eggs from Clutch 6, and critically read several drafts of the manuscript. Dean Moss also read the manuscript and assisted in Bush Thick-knee observation. Ian Venables kindly provided information from the Brisbane Wildlife Survey and information on Bush Thick-knee distribution in Brisbane. Jonathon Starks provided data from the RAOU Nest Record Scheme. For making their personal observations available to me I would like to thank R. Dickson, I. Flinders, M. Franklin, D. Muir and J. Noyce.

REFERENCES

- ALEXANDER, W.B. c1925. *Ornithological observations in Australia between 1912 and 1925*. 360 pp. Unpublished. (Typed volume held by the Queensland Museum Library derived from the original cards held by the Australian National Library, Canberra).
- ARTHUR, M.J. 1973. Notes on the breeding of the Southern Stone Curlew on the Adelaide Plains. *S.A. Ornithologist* 26: 115-116.
- BEDGGOOD, G.W. 1977. Field notes on the Southern Stone-Curlew in Victoria. *Aust. Bird Watcher* 7: 35-40.
- BERULDSEN, G. 1980. *A Field Guide to the Nests and Eggs of Australian Birds*. Adelaide: Rigby.
- BLAKERS, M., DAVIES, S.J.J.F. & REILLY, P.N. 1984. *The Atlas of Australian Birds*. Melbourne: Melbourne University Press.
- BRAVERY, J.A. 1970. The birds of the Atherton Shire, Queensland. *Emu* 70: 49-63.
- BRIGHT, J. 1935. Some habits of the Southern Stone Curlew. *Emu* 34: 159-163.
- BURRELL, H. 1909. Young Stone-plovers (*Burhinus grallarius*) and shingle. *Emu* 8: 150.
- CLELAND, J.B. 1906. Some bird observations. *Emu* 5: 189-192.
- CRAMP, S. & SIMMONS, K.E.L. (Eds.). 1983. *Handbook of the Birds of Europe, the Middle East and North Africa. The Birds of the Western Palearctic*. Volume 3. Waders to Gulls. Oxford: Oxford University Press.
- DAVIES, W. 1983. *Report of the Brisbane Wildlife Survey (April 1980 - October 1981)*. Brisbane: Wildlife Preservation Society of Queensland.
- FILMER, I.G. 1946. The birds of Victoria Park, Brisbane. *Qld Nat.* 13: 34-39.
- GARNETT, S. 1985. Nesting behaviour of the Bush Thick-knee. *The Stilt* 7: 24-25.
- HANDO, R. 1988. (Ed.). *Birds of southern, central inland Queensland*. In *Going Bush with Chinchilla Nats*: 12-32. Chinchilla: Chinchilla Field Naturalists Club.
- HAYMAN, P., MARCHANT, J. & PRATER, T. 1986. *Shorebirds: an identification guide to the waders of the world*. London: Croom Helm.
- HINDWOOD, K.A. 1971. Bush curlews - attachment to a locality. *Birds* 6: 18-19.
- HOBBS, J.N. 1961. The birds of south-west New South Wales. *Emu* 61: 21-55.

- INGRAM, G. 1976. Birds from some islands of the Torres Strait. *Sunbird* 7: 67-76.
- LANE, B.A. 1987. *Shorebirds in Australia*. Melbourne: Nelson.
- LASHMAR, A.F.C. 1937. Nesting activities in the eastern portion of Kangaroo Island. Season 1936-7. *S.A. Ornithologist* 14: 59-64.
- LAVERY, H.J. 1969. Collisions between aircraft and birds at Townsville, Queensland. *Qld J Agric. Animal Sci.* 26: 447-455.
- LINDGREN, E. 1971. Records of new and uncommon species for the island of New Guinea. *Emu* 71: 134-136.
- MacGILLIVRAY, W. 1923. Interesting conduct of the Southern Stone-Plover (*Burhinus magnirostris*). *Emu* 22: 309-311.
- McGILP, N. 1947. The Southern Stone Curlew (*Burhinus magnirostris*). *S.A. Ornithologist* 18: 44-46.
- McKENZIE, W.D. 1969. Living with nature, five miles from the GPO. *Qld Nat.* 19: 65-69.
- MACLEAN, G.L. 1985. *Roberts' Birds of Southern Africa*. Fifth edn. Cape Town: Trustees of the John Voelcker Book Fund.
- MATHEWS, G.M. 1913-1914. *The Birds of Australia*. Volume 3. London: Witherby and Company.
- MEINERTZHAGEN, A.C. 1924. A Review of the genus *Burhinus*. *Ibis* 11th Series. 6: 329-356.
- NORTH, A.J. 1913-1914. *Nests and Eggs of Birds found Breeding in Australia and Tasmania*. Volume iv. Sydney: Australian Museum.
- PERKINS, D.L. 1975. Queensland Ornithological Society. Annual Bird Count, 1974. *Sunbird* 6: 8-14.
- PRINGLE, J.D. 1987. *The Shorebirds of Australia*. Sydney: Angus and Robertson.
- ROBERTS, G.J. 1979. *The Birds of South-East Queensland*. Brisbane: Queensland Conservation Council.
- SCHODDE, R. & MASON, I.J. 1980. *Nocturnal Birds of Australia*. Melbourne: Lansdowne.
- SELBY, A.D. 1951. Stone-Plover afloat. *Emu* 51: 168.
- SERVENTY, D.L. & WHITTELL, H.M. 1967. *Birds of Western Australia*. Perth: Lamb Publications.
- STORR, G.M. 1984. Revised List of Queensland Birds. *Rec. West. Aust. Mus. Suppl.* 19.
- VENABLES, I. 1983. *Birds*. In *Wildlife of the Brisbane Area* (W. Davies ed.) pp 54-79. Brisbane: Jacaranda Press.
-

-
- VERNON, D.P. 1968. *Birds of Brisbane and Environs*. Brisbane: Queensland Museum.
- VERNON, D.P. & MARTIN, J.H.D. 1975a. Birds of Moreton Island and adjacent waters. *Mem. Qld Mus.* 17: 329-333.
- VERNON, D.P. & MARTIN, J.H.D. 1975b. Birds of Stradbroke Island. *Proc. Roy. Soc. Qld.* 86: 61-72.
- WATSON, R. 1976. Birdlist - Victoria Park, Brisbane - 1970-74. *Qld Nat.* 21: 140-141.
- WHEELER, W.R. 1967. The birds of Cairns, Cooktown and the Atherton Tablelands. *Aust. Bird Watcher* 3: 55-76.
- WIENEKE, J. 1988. *Birds of Townsville and Where to Find Them*. Townsville: Wildlife Preservation Society of Queensland.
- ZIETZ, F.R. 1917. Note on the Stone Plover (*Burhinus magnirostris*). *S.A. Ornithologist* 3: 44.
-

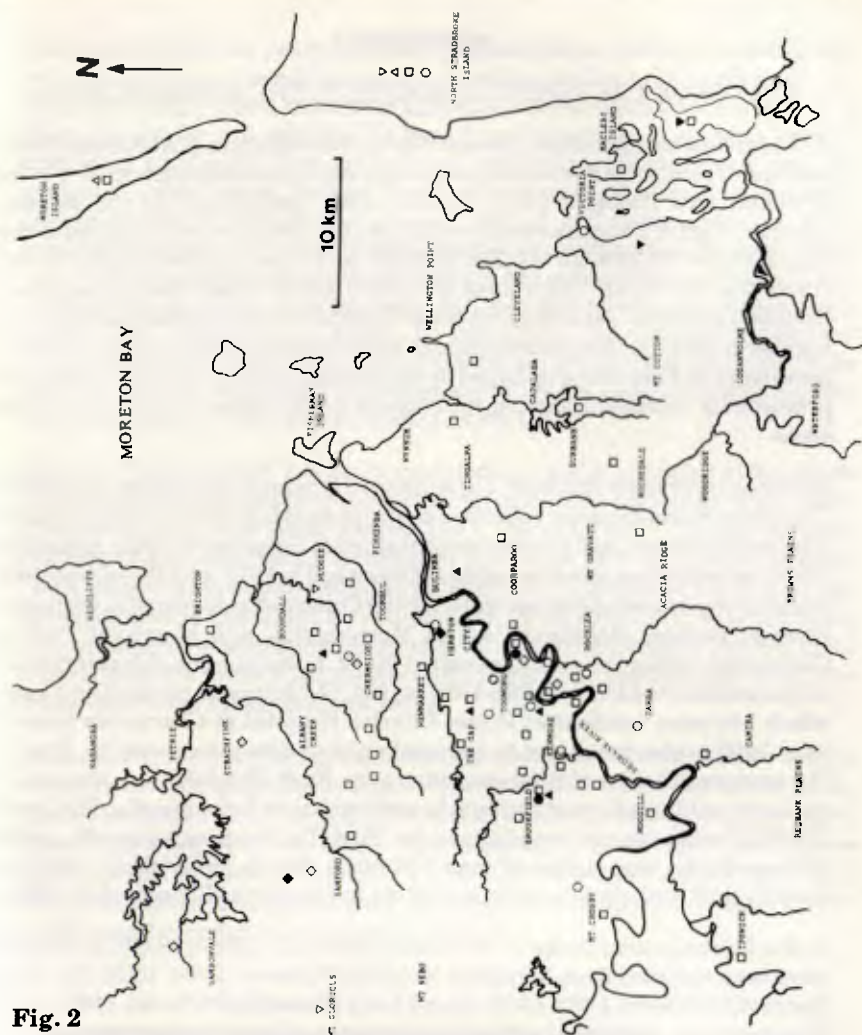


Fig. 2

Records of the Bush Thick-knee in the Brisbane area since 1970. The sources of the records are as follows: □ Brisbane Wildlife Survey (Davies 1983); △ Other published records (Perkins 1975, Venables 1983, Vernon & Martin 1975 a,b); ○ Queensland Ornithological Society Newsletter (1977. March [Suppl.] : 5, April [Suppl.] : 4; 1979. 10(3): 6; 1983. 14(11): 10; 1984. 15(3): 9,11; 1985. 16(7): 6, 16(8): 10, 16(10): 5, 16(11): 4; 1988. 19(3): 9, 19(4): 9, 19(11): 7; 1990. 21(2): 5, 21(6): 8); ◇ Queensland Museum; ▽ Personal observations (G. Anderson, R. Dickson, I. Flinders, M. Franklin, D. Muir, J. Noyce). The solid symbols indicate breeding records.

APPENDIX 1

STATUS OF THE BUSH THICK-KNEE IN THE BRISBANE AREA.

Although less common than it was earlier in the century (e.g. Alexander 1925), the Bush Thick-knee remains a moderately common to uncommon bird in the Brisbane area (Roberts 1979, Davies 1983), particularly in the western suburbs. Figure 2 summarises records from the last 20 years, using data from the Brisbane Wildlife Survey (Davies 1983) and other sources. Vernon (1968) states that the Bush Thick-knee is "... still about outer urban [areas] and Brisbane environs", and the Brisbane Wildlife Survey revealed a surprising number of birds in the suburbs close to the city centre (Davies 1983). Most of these records were probably based on the characteristic call of the species and presumably represent feeding individuals and/or those in transit to other areas.

Breeding records for the Bush Thick-knee in Brisbane are far less numerous. The Queensland Museum collection contains eggs taken early in the century, labelled 'Brisbane', and a clutch was obtained at Enoggera in 1901. Alexander (1925) records the species breeding at Sherwood in 1921, and Venables (1983) lists more recent breeding records for Xavier College at Indooroopilly, Simpson's Road at Bardon, Balmoral Park at Morningside, and Marchant Park at Chermside. A long time resident pair at the St. Lucia campus of the University of Queensland bred in the 1988-1989 season (D. Muir pers. comm.), and a pair which has been resident at Prince Charles Hospital at Chermside since at least 1985 is also presumed to be breeding (J. Noyce pers. comm.). Even in the western suburbs of Brisbane, where the Bush Thick-knee is reasonably common, published breeding records are few (e.g. at Indooroopilly, McKenzie [1969]). During the non-breeding season, Bush Thick-knees reportedly gather in loose flocks, sometimes of over 100 birds (North 1913-1914), but more usually 5-10 birds in the south and 30-40 in the north (Blakers *et al.* 1984).

In the Brisbane area flocks of 10 (no date given), 11 (June) and 8 (July) birds have been reported from Slaughter Falls (QOS Newsl. 1984. 15(3): 11), West Darra (QOS Newsl. 1985. 16(7): 6) and Long Pocket (QOS Newsl. 1985. 16(8): 6) respectively, and these probably represent non-breeding aggregates. The composition of such non-breeding groups of Thick-knees has been poorly studied. It is possible that the groups, and particularly the smaller groups in the south, consist predominantly of young birds which have yet to pair off and establish their own territories, while pairs with established breeding territories are found in that area for most of the year. Indeed, the established pair of birds under study remained at Herston for all (1989-1990) or most (1988-1989) of the year.

Over a period of many years, the Bush Thick-knee has declined in both range and abundance in the southeast of Australia, particularly in areas in and around the major cities, but also in agricultural areas (Blakers *et al.* 1984.) A major reason for this decline has been the destruction of suitable habitat associated with urban and agricultural expansion. Birds which have remained in urban areas, such as those in Brisbane and cities further north, have been able to utilize man-made habitats (e.g. golf courses, playing fields, lawns and gardens) to retain viable populations within the city area. Similarly, intense land clearance for agriculture has reduced the number of Bush Thick-knees in many country areas, but has not totally eliminated them (Hobbs 1961, Blakers *et al.* 1984). In addition to loss of habitat, increased human population poses additional problems for a nocturnal bird such as the Bush Thick-knee in the form of greater mortality due to collisions with motor vehicles (Bravery 1970) and aircraft (Lavery 1969).

The Fox *Vulpes vulpes* has been considered a major predator of the Bush Thick-knee and appears to be one factor responsible for its decline in a number of areas (North 1913-1914, McGilp 1947, Pringle 1987). On the western Darling Downs, the recent increase in the range and abundance of Bush Thick-knees has been attributed to programmes to eradicate the Fox, Dingo *Canis familiaris* and feral cat (Hando 1988). Foxes and feral cats are likely to be important in restricting Thick-knee numbers in Brisbane. Davies (1983) reports that the areas with the greatest Thick-knee populations tend to be areas with fewer foxes, and vice versa.

In summary, the Bush Thick-knee does not appear to be in immediate danger of extinction in the Brisbane area. The cryptic and nocturnal habits of the species combined with a certain tolerance of human proximity combine to give these birds a degree of resilience. The species is likely to remain common on the fringes of the metropolitan area, and the maintenance of suitable parkland within suburban Brisbane is likely to continue to support a small yet fairly stable population for many years to come.

G. J. ANDERSON, 34 Hornby St., Everton Park, Q. 4053.

A RED-FOOTED BOOBY FROM ABERGOWRIE STATE FOREST, NORTH QUEENSLAND.

Pizzey (1980) gives the range of the Red-footed Booby *Sula sula* as tropical Atlantic, Pacific and Indian Oceans; in Australia, breeds on Raine Island, North Queensland, and various cays in the Coral Sea, south to the Capricorn Group; also Ashmore Reefs in Western Australia. He considers the species to be local and uncommon.

On 26 December 1990 we discovered several piles of primaries and rectrices scattered in the characteristic fashion of a feeding hawk, in tall open forest adjacent to closed forest (complex mesophyll vine forest), near the entrance to Abergowrie State Forest (SF 591) (18°29'S, 146°02'E), 31km northwest of Ingham, North Queensland.

The feathers proved extremely difficult to identify, until one of us (LGC-C) located the partially eaten, slightly decomposed, carcass of a Red-footed Booby which was identified from the description given on page 48 and the details on plate 6 of Pizzey (1980). At this time severe tropical cyclone 'Joy', a category 4 cyclone, was situated approximately 100 km east of Cairns in the Coral Sea. Given that cyclonic winds move clockwise around the central core, this would account for the Booby being blown inland, where in a weakened state it was taken, almost certainly by a goshawk. Female Grey Goshawks *Accipiter novaehollandiae* and female Brown Goshawks *A. fasciatus*, which occur in the area, are both quite capable of taking a weakened Booby.

ACKNOWLEDGEMENTS

We thank the Ingham Office of the Queensland Department of Forestry for access into Abergowrie State Forest, and Richard Rowe for reading a draft of this manuscript.

REFERENCE

PIZZEY, G. 1980. *A Field Guide to the Birds of Australia*. Sydney:Collins.

ANDREW M. BURTON, Department of Zoology, James Cook University of North Queensland, Townsville, Q 4811.

LILIAN G. CHAVEZ-CHAVEZ, Morena 703 #3, Esq. c/Rebsamen, Col. Del Valle, C.P. 03100, Z.P. 12, MEXICO, D.F.

TOM J. CADE & RENETTA CADE, The Peregrine Fund, Inc., World Center for Birds of Prey, 5666 West Flying Hawk Lane, Boise, Idaho 83709, U.S.A.

BOOK REVIEW

FIFTY YEARS OF BIRD STUDY IN NEW ZEALAND. B.D. Heather and P.M. Sheehan. Random Century in association with O.S.N.Z., Auckland, 1990, 217 pages.

A FLYING START. B.J. Gill and B.D. Heather.
O.S.N.Z. inc. Lower Hutt, 1990, 295 pages, \$30.00 (approx.).

To commemorate 50 years of bird study in New Zealand, the Ornithological Society of New Zealand has produced two informative books, one describing the history of New Zealand ornithology, the other providing a comprehensive indexed listing of articles appearing in *Notornis* since its inception in 1939.

For those wishing to delve more deeply into the bird literature of New Zealand, 'Fifty years of bird study in New Zealand' provides a valuable index of material published in New Zealand's bird journal *Notornis*. This journal began as a series of cyclostyled reports dating from 1939 (New Zealanders would obviously never let a mere war interfere with their birding). Barrie Heather and Tricia Sheehan have done a fine job in indexing the complete list of articles, cross-referenced by subject and author. The diverse subject index makes the book convenient to use and should serve as a useful resource.

Perhaps of greater interest to the casual reader is the companion volume entitled 'A Flying Start'. This book is not intended to be a basic text on ornithology, but a historical account of the emergence of ornithology as a scientific discipline in New Zealand. It has been written by some forty contributors, beginning with a description of the society's achievements such as bird banding and nest record schemes, bird atlas projects and, of course, the society's publication *Notornis*. Although informative, this first section lacks general interest and at times reads more like an annual report than an absorbing description of ornithological activities.

The following section is a series of reminiscences from founding or long standing members of the society, recounting some of the memories of early bird watching days. One particularly revealing incident was the delight Brian Marples felt when, on first arriving in New Zealand in 1937, he discovered a large roost of European Starlings. Today, introduced species such as the Starling are New Zealand's most common birds.

I found the third section of the book entitled 'Ornithological Reviews' by far the most interesting. It recounts the fascinating evolution of New Zealand's avifauna, pointing out that 81 of the 193 species that regularly breed in the

New Zealand region do so nowhere else. This section also describes some of the peculiar habits of New Zealand's birds. The Kiwi, for example, has an unusually low body temperature and slow metabolic rate, and for some reason does not turn its egg during incubation. A theme repeated throughout the third section is the tragic plight of so many of New Zealand's unique species. Eleven per cent of the world's endangered bird species listed in the Red Data Book are found in New Zealand. An incredible 33 species have been lost since polynesian settlement (only a thousand years ago) and a further ten, at least, since European settlement. This means that almost half of New Zealand's complement of terrestrial birds has been lost in less than a thousand years! There are many other topics covered in this section of the book; everything from bird art in New Zealand to genetic studies on New Zealand's birds, providing something for everyone. The final section of the book lists 23 short biographies of a selection of people figuring in the development of ornithology in New Zealand.

Although presented professionally, I was disappointed not to find any colour photographs to improve the visual appeal of the book and provide some relief from the less entertaining parts. The text was also disjointed at times, a legacy perhaps of covering such a broad range of subjects. However, this need not detract from its value to someone wanting a crash course in New Zealand ornithology. For this purpose, these two commemorative books serve the purpose well, doing credit to the people who founded ornithology across the Tasman.

*JEREMY THOMPSON, Zoology Dept., University of Queensland,
St. Lucia, Q 4067.*

INSTRUCTIONS TO AUTHORS

The Sunbird is published quarterly by the Queensland Ornithological Society to further the knowledge of birds in Queensland and adjacent northern regions of Australia.

Papers are invited from non-members as well as members on all aspects of ornithology, e.g. life history, taxonomy, distribution, behaviour, and ecology. Articles may take the form of major articles on specific birds, birds in specific areas or habitats, or short notes on either birds themselves or the literature on birds, such as reviews of books or comments on published articles.

Submission of a paper implies that the results reported have not been published and are not being considered for publication elsewhere. The editor reserves the right to submit records of rare birds to the Records Appraisal Committee of the Royal Australasian Ornithologists Union.

Manuscripts can be supplied on floppy disk (IBM or MACINTOSH systems using plain text 'ASCII format') or in typed form on paper. When typed, the manuscript should be double-spaced and two copies sent. Papers longer than four typed A4 pages should have a summary. If needed, help may be given to authors to find relevant literature. Common names, scientific names and order of names should follow 'Recommended English Names for Australian Birds', in *The Emu* Volume 77, Supplement, 1978. Intending authors should consult recent issues of *The Sunbird* to see acceptable forms of contributions.

References should be listed in alphabetical order at the end of papers in the following styles; titles of journals will be abbreviated as in the *World List of Scientific Periodicals*:

FLEAY, D.H. 1937. Nesting habits of the brush turkey. *Emu* 36: 153-163.

FRITH, H.J. (Ed.). 1976. Mallee fowl. In *Complete Book of Australian Birds*, pp. 136-137. Sydney: Reader's Digest.

SERVENTY, D., SERVENTY, V.N. & WARHAM, J. 1971. *The Handbook of Australian Sea-birds*. Sydney: Reed.

SLATER, P. 1970. *A Field Guide to Australian Birds. Non-Passerines*. Adelaide: Rigby.

Tables and Figures should be numbered with Arabic numerals. Drawings and diagrams should be in Indian Ink on cartridge paper or tracing cloth. If authors cannot arrange suitable drawings, the editor may arrange the drawing of figures and diagrams. Authors may submit photographs (preferably black and white) with their manuscripts.

Reprints are not supplied gratis. Authors may order reprints within one month after publication.

Manuscripts should be sent to:

The Editor, *The Sunbird*, Queensland Ornithological Society Inc.,
P.O. Box 97, St. Lucia, Queensland, 4067.