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SEASONAL AND ANNUAL VARIATIONS IN THE BIRDS OF AN URBAN GARDEN IN TOOWOOMBA, SOUTH-EAST QUEENSLAND

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ABSTRACT

This six year survey yielded sightings of 55 bird species which fell into three distinct categories with regard to their frequency of occurrence in the garden. More species and more birds used the garden during the cooler and drier months than at other times of the year. The correlates of annual variations were not demonstrable. The habitat requirements of many local bird species cannot be met in urban gardens but could and should be created in city parks.

INTRODUCTION

A well-vegetated urban garden, even if quite small, can provide food, shelter and perhaps to a lesser extent, nesting sites, for a diversity of bird species. The vegetation structure and floristic composition of urban gardens is in many ways different from that of nearby bushlands. The garden usually has many plant species which do not occur naturally in the area and plants with large flowers, a long flowering period, or abundant berries are favoured. Rainfall to the garden is often supplemented from external sources.

Urban gardens may therefore support bird species whose requirements are not well provided for by the area's natural habitats. The more equitable garden environment would also be expected to give some native birds a refuge during times of food shortage. Collectively the gardens of a city may make a very large contribution to the abundance and diversity of a region's bird life. There is considerable interest then in documenting garden bird species and trying to understand how they exploit this man-made environment; and this was the aim of the present study.

METHODS AND STUDY AREA

The idea for this survey and the methodology was originally proposed as a project to Queensland Ornithological Society members by Dr. Peter Woodall. From intermittent observations on most days over six years one of us (H. McKilligan) recorded the maximum weekly flock size of each species seen in our Toowoomba garden. A 'flock' was defined as the number of birds of the species in the garden at any one time. Birds flying overhead were not included.

Toowoomba (151°57'E, 27°35'S) has an altitude of about 650 m and a mean annual rainfall of 970 mm, most of which falls in the warmer months of the year. Mean summer and winter temperatures are 27.6°C and 17°C. The garden is on the outskirts of the city separated from the nearest bushland (sclerophyll forest) by 300 m of housing and pasture land.

The garden is in an average-sized suburban allotment and has an area of 550 m^2 approx. It was developed from grassland ten years prior to the start of the survey and is about two-thirds lawn and one-third shrubs and small trees (to a height of 8 m approx.) with a small vegetable patch. It has more tall shrubbery than most local gardens. Water was provided in a bird bath during most of the survey (from about 1980 onwards). The birds were not fed by us although next-door neighbours regularly fed the Australian Magpies during the first four years of the survey. The garden was part of the home range of two or three cats but these were not encouraged.

RESULTS

The survey encompassed the period July 1979 to June 1985. In this time we were away from home for periods of two or three weeks on six occasions during winter months and there were also a number of shorter absences. The data are grouped by month for analysis with each month having at least two weeks of observations. Fifty-five bird species were identified, including 16 non-passerine species. No nesting was observed. Tall dense *Melaleuca* sp. and *Elodea* sp. were used as night roosts.

Occasional, frequent and common bird visitors

The frequency distributions of sightings fall into three well-separated groups of species (Fig. 1) termed here 'Occasional Visitors', 'Frequent Visitors' and 'Common Visitors' (Appendix 1 and Table 1).

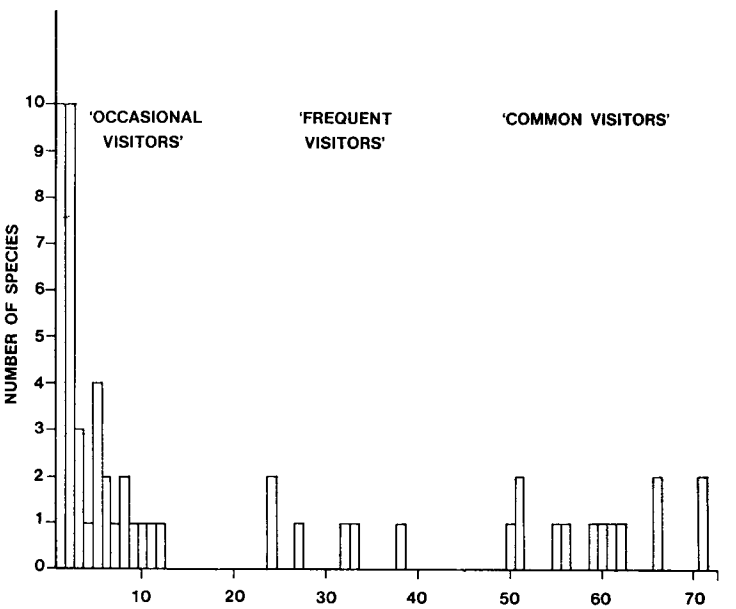

Figure 1 : Number of months in which each species was recorded, out of 72.

The Occasional Visitors, comprising 37 species, were seen in from 1 to 12 months of the 72 month survey. They included a single sighting of the Shining Bronze Cuckoo, a rarely seen sub-species from New Zealand; the Koel, an annual summer migrant to Toowoomba which generally prefers taller trees than ours; the Eastern Rosella, just north of its usual range; and the White-faced Heron, common on local wet pastures but not normally seen on suburban lawns.

The Frequent Visitor category had six species and were those seen in 24 to 38 of the months. Among these were regular winter visitors such as the Eastern Spinebill and Willie Wagtail, and others like the Noisy Miner which showed no seasonal pattern being common throughout some years of the survey and scarce in others.

TABLE 1

List of 'Common Visitor' species (those recorded in 50-71 months) and their maximum flock sizes summed by month over the period July 1979 to June 1985.

	J	F	M	A	M	J	J	A	S	O	N	D
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	7	10	12	18	18	22	29	28	21	12	8	4
Noisy Friarbird *Philemon corniculatus*	10	11	6	10	8	2	6	3	7	13	6	5
Brown Honeyeater *Lichmera indistincta*	14	13	10	22	22	20	21	12	11	11	9	10
Silvereye *Zosterops lateralis*	9	21	42	32	97	85	96	79	25	22	20	11
House Sparrow *Passer domesticus*	57	63	72	50	44	39	41	71	60	47	78	53
Common Starling *Sturnus vulgaris*	69	23	8	6	100	52	21	13	18	36	24	55
Common Myna *Acridotheres tristis*	14	9	13	18	18	19	21	31	18	15	16	12
Australian Magpie-lark *Grallina cyanoleuca*	9	14	16	15	15	12	18	15	10	10	7	10
Pied Butcherbird *Cracticus nigrogularis*	8	7	10	12	7	6	11	6	5	4	7	5
Australian Magpie *Gymnorhina tibicen*	24	34	32	33	26	36	56	36	44	28	26	26
Pied Currawong *Strepera graculina*	5	8	11	36	19	32	36	41	22	23	7	11
Torresian Crow *Corvus orru*	13	12	8	9	12	10	13	10	12	9	5	8

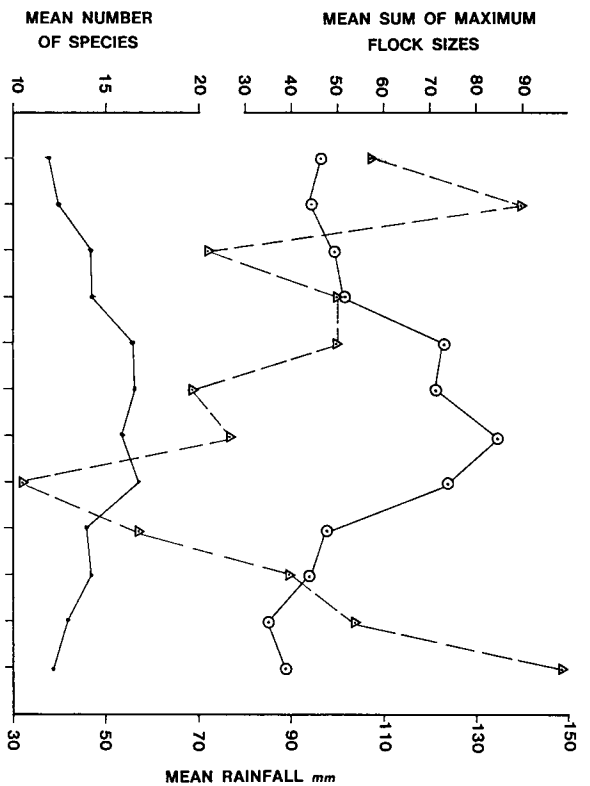

Figure 2: Mean monthly number of species (⊙——⊙); Mean sum of maximum flock sizes (•——•); Mean rainfall (△—△—△) by month for July 1979 – June 1985.

The 12 Common Visitor species were seen the year round in Toowoomba and were recorded from 50 to 71 months of this survey. Three introduced species (House Sparrow, Common Starling and Common Myna) represented 37.2% of the total number of Common Visitors (calculated from the summed maximum flock sizes). Most often recorded (in 71 of the 72 months) were the House Sparrow and the Australian Magpie. The House Sparrow and Silvereye formed the largest flocks (mean max. flock = 9.6 and 8.2 respectively) and were probably the most numerous species in the garden.

Major food sources were the lawn (for animal foods), flowering *Callistemon* and *Grevillea* (for nectar), *Cotoneaster* and *Elaeocarpus* for berries, and all shrubs, but especially *Acacia baileyana*, for insects. Among these common bird species six were omnivores, three insectivore/carnivores, and three nectarivore/insectivores.

Seasonal and Annual Variations

Seasonal variations. There was a distinct seasonal pattern in the number of species using the garden (Fig. 2) with more than 16 species seen per month, on average, from May to August, reducing to less than 13 per month from December to February ($t = 4.3$, $P < .01$, 34 d.f.). The mean monthly number of species showed a significant inverse correlation with mean monthly rainfall ($t = 5.8$, $P < .001$, 15 d.f., Welch's Test).

The numbers of birds (sums of maximum flock sizes) showed a similar seasonal pattern to species numbers, with the largest totals from May to August and the lowest in November and December (Fig. 2) ($t = 6.6$, $P < .001$, 32 d.f.). This winter increase was also apparent when numbers were calculated as mean maximum flock per species, so it was not simply due to the presence of more species then. Maximum flock size totals did not correlate significantly with monthly rainfall, however.

The winter increase in numbers was mostly due to marked increases then in Common Visitor species such as Black-faced Cuckoo-Shrike, Brown Honeyeater, Silvereye and Pied Currawong and to a lesser extent the Australian Magpie (Table 1). Other common species showed little or no seasonal variation (Noisy Friarbird, Magpie Lark, Pied Butcherbird, Common Myna and Torresian Crow). The House Sparrow and Starling numbers varied in a gross, irregular way. Thus the largest flock in the garden was 69 Starlings one May, but flocks of 29 and 25 Starlings were seen in December and January also.

Annual variations. The annual number of species seen was highest in 1982 but the mean maximum flock size (all species combined) was highest in 1980 (Table 2). Both were years of lower than average rainfall. There seemed to be a negative power function relating the number of species with rainfall for the same year (r = -1.79) but there are too few data to validate this. Annual maximum flock sizes showed no obvious relationship with rainfall of preceding or concurrent months.

There was a progressive reduction in the flock sizes of the Black-faced Cuckoo-Shrike, Magpie Lark and Pied Butcherbird from 1980 to 1985 and of the Australian Magpie from 1981.

TABLE 2

Number of species, monthly means of maximum flock sizes and annual rainfall for the five complete years of observation.

	1980	1981	1982	1983	1984
Total number of species	31	29	36	28	31
Monthly means of summed maximum flock sizes	68.4	46.5	50.8	50.9	46.0
Standard deviation	28.2	18.8	21.6	25.0	12.0
Annual rainfall mm	954	1478	897	1357	1003

DISCUSSION

Chance must play a large part in bringing the less common birds to a small garden such as this, but hopefully this drawback has been offset by the high frequency of observations spanning 72 months. The 55 bird species recorded here represent less than one-third of the 171 species recorded by members of the Toowoomba Bird Club over the past 11 years (L. Beaton pers. comm.) but TBC's surveys ranged widely over the urban, agricultural and bushland areas within the city's boundary.

The apparent discreteness of the three groups of sighting frequencies requires some explanation. The Common Visitor group of species obviously were birds which found food in the garden throughout the year. The Occasional Visitors were so rarely seen they presumably either found the garden attractive only when conditions were unusually unfavourable in their natural habitats or they had made a chance landing in the

garden to rest while in transit. The intermediate frequencies of occurrence of the Frequent Visitors were expected for seasonal visitors such as the Eastern Spinebill and Wagtail, and, less obviously, the Pale-headed Rosella, but the other three, Crested Pigeon, Little Friarbird and Noisy Miner, showed no seasonal pattern and there seemed no ready explanation for their occurrence at these intermediate frequencies.

Native bird species were well-represented in this garden (94.5% of the total species). Green (1984) showed that native birds fed more on native than on exotic plants in Melbourne gardens and most plants in the present garden are native. It's proximity to local bushlands may also be an influencing factor, although a recent Brisbane study found no difference in the diversity of native bird species at urban sites near (0.25 - 0.5 km) and distant (2 - 3 km) from native forest (D. Jones and C. Catterall pers. comm.). This garden also apparently provided well for the needs of the introduced House Sparrow, Common Starling and Common Myna which represented 25% of the common species and yet comprised 37.2% of the total number of these birds. One or more of these exotics have been found to be a major component of the urban bird community in Wagga Wagga (Jones 1981), Townsville (Jones 1983) and Melbourne (Green 1984 and Mason 1985). These introduced species, and some common native ones, seem to be mostly exploiting the mown grass which comprises a large proportion of this (and most) gardens, but the House Sparrow at least also fed in the shrubbery and vegetable garden.

Native species common in local bushlands and grasslands but rarely or never seen in this garden included the fairy wrens, grey fantail, the arboreal thornbills, tree creepers, pardalotes, Golden-headed Cisticola and finches. Cats may take a heavy toll of small birds which forage close to the ground, but for many bird species the vegetation structure of most gardens is clearly unsuitable. In order to attract a wide variety of bird species to a city it therefore seems most desirable that urban parks should have some native forest, extensive thickets of native shrubbery and areas of rank grass, to meet the needs of local bird species not catered for by gardens.

The weekly record of maximum flock size does not tell us how much of the week the birds spent in the garden nor their average flock size. Moreover, if used as a measure of the intensity of useage of the garden by birds, this figure will tend to overestimate useage by birds which temporarily form larger,

more wide-ranging flocks when foraging. For example, in the seasonally flocking Pied Currawong, the three-fold winter increase in maximum flock sizes would not represent a corresponding increase in this species' use of the garden if it then visited less frequently than before. However the impression gained was of more rather than less time being spent in the garden by birds during winter months and maximum flock size may be taken to be a rough index to overall useage of the garden by birds.

These data seem to amply demonstrate the role of this suburban garden as a winter refuge for native birds, with more species and more birds using the garden during the cooler months of the year. Winter rainfall was generally less than in other months of the survey and this combined with low temperatures probably reduced the food available in local bushlands for many bird species. A winter scarcity of arthropod food for birds has been described for woodlands of the NSW Northern Tablelands (Bell 1984) and for open forests near Sydney (Pyke 1985). By contrast nectar bearing flowers (especially *Grevillea* spp.) and *Cotoneaster* berries were more available in winter than in summer in the garden.

More bush birds would be expected to be driven to use the garden in low than high rainfall years, and the data suggest that such an inverse relationship exists for numbers of species although, surprisingly, not for maximum flock sizes. Clearly more years of observation are desirable, especially in an area such as this which is still undergoing urbanization. The trend towards reduced numbers of Black-faced Cuckoo-shrike, Magpie Lark and Pied Butcherbird described here to 1985 continued throughout 1986 and may have resulted from the progressive loss of the grassland, which originally lay between this garden and the nearest bushland, to houses over this period.

ACKNOWLEDGEMENTS

We thank Darryl Jones and Carla Catterall for supplying details of their recent study of Brisbane birds and Peter Woodall for providing the initial stimulus and methodological guidelines for this study. Darryl Jones also made a number of helpful comments on a first draft of this paper.

REFERENCES

Bell, H.L., 1985. Seasonal variation and the effects of drought on the abundance of arthropods in savanna woodland on the Northern Tablelands of New South Wales. Aust. J. Ecol. 10(3), 207-221.

Green, R.J., 1984. Native and exotic birds in a suburban habitat. Aust. Wildl. Res. 11(1), 181-190.

Jones, D.N., 1981. Temporal changes in the suburban avifauna of an inland city. Aust. Wildl. Res. 8(1), 109-119.

Jones, D.N., 1983. The suburban bird community of Townsville, a tropical city. Emu 83(1), 12-17.

Mason, P., 1985. The impact of urban development on bird communities of three Victorian towns - Lilydale, Coldstream and Mt. Evelyn. Corella 9(1), 14-21.

Pyke, G.H., 1985. Seasonal patterns of abundance of insectivorous birds and flying insects. Emu 85(1), 34-39.

APPENDIX 1

List of 'Occasional' and 'Frequent' Visitor Species
(See Table 1 for 'Common Visitors')

Occasional Visitors (recorded in 1-12 months)

White-faced Heron *Ardea novaehollandiae*
Collared Sparrowhawk *Accipter cirrhocephalus*
Australian Hobby *Falco longipennis*
Galah *Cacatua roseicapilla*
Rainbow Lorikeet *Trichoglossus haematodus*
Scaly-breasted Lorikeet *Trichoglossus chlorolepidotus*
Eastern Rosella *Platycercus eximius*
Brush Cuckoo *Cuculus variolosus*
Fan-tailed Cuckoo *Cuculus pyrrhophanus*
Shining Bronze Cuckoo *Chrysococcyx lucidus lucidus*
Common Koel *Eudynamis scolopacea*
Southern Boobook *Ninox novaeseelandiae*
Laughing Kookaburra *Dacelo novaeguineae*
Sacred Kingfisher *Halcyon sancta*
Dollarbird *Eurystomus orientalis*

White-bellied Cuckoo-shrike *Coracina papuensis*
White-winged Triller *Lalage sueurii*
Rufous Whistler *Pachycephala rufiventris*
Golden Whistler *Pachycephala pectoralis*
Grey Shrike-thrush *Colluricincla harmonica*
Leaden Flycatcher *Miagra rubecula*
Restless Flycatcher *Miagra inquieta*
Grey Fantail *Rhipidura fuliginosa*
Superb Fairy-wren *Malurus cyaneus*
Variegated Fairy-wren *Malurus lambertii*
Yellow-rumped Thornbill *Acanthiza chrysorrhoa*
Striated Thornbill *Acanthiza lineata*
Red Wattlebird *Anthochaera carunculata*
Spiny-cheeked Honeyeater *Acanthagenys rufogularis*
Blue-faced Honeyeater *Entomyzon cyanotis*
Lewin's Honeyeater *Meliphaga lewinii*
Yellow-faced Honeyeater *Lichenostomus chrysops*
Scarlet Honeyeater *Myzomela sanguinolenta*
Spotted Pardalote *Pardalotus punctatus*
Olive-backed Oriole *Oriolus sagittatus*
Figbird *Sphecotheres viridis*
Satin Bowerbird *Ptilonorhynchus violaceus*

Frequent Visitors (recorded in 24-38 months)

Crested Pigeon *Ocyphaps lophotes*
Pale-headed Rosella *Platycercus adscitus*
Willie Wagtail *Rhipidura leucophrys*
Little Friarbird *Philemon citreogularis*
Noisy Miner *Manorina melanocephala*
Eastern Spinebill *Acanthorhynchus tenuirostris*

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THE IDENTITY OF TWO TAXA IN THE GENERA *CORVUS* AND *LONCHURA*

N.W. LONGMORE

In the course of preparing a list of the type specimens of birds in the Australian Museum, Sydney (Longmore in prep.), I encountered two serious, nomenclatural problems. The type specimens of *Corvus bennetti* and *Lonchura castaneothorax ramsayi* are composite, i.e. they represent two species each, not one. Thus the names are ambiguous and could be applied to taxa other than those traditionally assumed. In each case, the sensible solution is to maintain the traditional scientific name.

Corvus bennetti

In 1901, A.J. North described *Corvus bennetti*, the Little Crow. North indicated he had both sexes, which he detailed. But "hidden" at the end of the paper, he mentioned a third specimen. This type specimen was overlooked by Hindwood (1946) when he composed his list of the types in the Australian Museum. He referred to only two specimens as having been nominated by North. Also, Hindwood chose these (Australian Museum A.18559, female, and A.18561, male) as "selected types". He apparently meant this to be the designation of lectotype and paralectotype, but he was not specific. Both specimens are Little Crows.

Rowley (1970), in his revision of the Australian crows, also did not mention the existence of the third type specimen. I have found the "missing" specimen. It is registered as Australian Museum A.18560, between the two specimens mentioned by Hindwood. The data in the register are identical for all three: collected at Moolah, New South Wales, in August 1883 by K.H. Bennett and W. Adam. The specimen is entered in the register as *Corvus coronoides*. My examination of the skin, which is an immature bird of unknown sex, confirmed the identification. Also, my measurements of the bird are consistent with those given by North for the third specimen. It thus seems reasonable that North, who was the Ornithologist at the Australian Museum, realised his misidentification of the third type in time to register it correctly.

The three type specimens are syntypes, i.e. the original specimens on which the author based his description and name. Each specimen has equal value in nomenclature. Thus the name, *Corvus bennetti*, can be applied to either the Little Crow or the Australian Raven. To preserve the name as that for the Little Crow, I designate one of the specimens of that taxon as lectotype. A lectotype is the unique bearer of the name and the standard for its application.

Corvus bennetti North 1901

Lectotype: A.18561

Paralectotypes: A.18559

A.18560 (= *Corvus coronoides*)

Lonchura castaneothorax ramsayi

The Papua New Guinean finch *Lonchura castaneothorax ramsayi* was first described as *Donacola nigriceps* by E.P. Ramsay (1877). His two syntypes were collected by Alexander Goldie in 1877 at the infant settlement of Port Moresby. Ramsay noted that one of the skins was in adult plumage, possibly a male, and the other was a "young bird". In a footnote (p.393), he remarked that the latter "may eventually prove to be the young of another species".

Delacour (1943) noticed that Ramsay's *nigriceps* had been applied previously to an African finch *Lonchura bicolor nigriceps* (Cassin). Because a name cannot be used twice in the same genus, he proposed the replacement name *Lonchura castaneothorax ramsayi*. To do this, Delacour did not need to examine Ramsay's types, even though they were also the types of his new name.

I have examined Ramsay's two syntypes and they are, in fact, two different species. His adult male (Australian Museum O.18745) is *Lonchura castaneothorax*, but his "young bird" (O.18746) is an adult *Lonchura caniceps* (Salvadori). I designate the former specimen as lectotype to preserve the existing usage of *Lonchura castaneothorax ramsayii*:

Lonchura castaneothorax ramsayi Delacour 1943

Lectotype: O.18745

Paralectotype: O.18746 (= *Lonchura caniceps caniceps*)

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REFERENCES

DELACOUR, J. 1943. A Revision of the Subfamily Estrildinae of the Family Ploceidae. *Zoologica 28*: 69-86.

HINDWOOD, K.A. 1946. A list of the types and paratypes of birds from Australian localities in the Australian Museum, Sydney, New South Wales. *Rec. Aust. Mus. 21*: 386 - 393.

LONGMORE, N.W. (in prep.) Type specimens of birds in the Australian Museum.

NORTH, A.J. 1901. Description of a new species of Crow. *Vic. Nat. 17*: 170.

RAMSAY, E.P. 1877. Notes on a Collection of Birds from Port Moresby with descriptions of some *new species*. *Proc. Linn. Soc. N.S.W. 1*: 386-395.

ROWLEY, I. 1968. The genus *Corvus* (Aves: Corvidae) in Australia. *SCIRO Wildl. Res. 15*: 27-71.

SALVADORI, T. 1876. Catalogo di una seconda collezione di ucelli raccolti dal Sig. L.M. D'Albertis nell' Isola Yule e sulla vicina costa della Nuova Guinea e di una piccola collecczione della regione bagnata dal Fiume Fly. *Ann. Mus. Civ. Genova 9*: 1-49.

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YELLOW-LEGGED FLYCATCHER REPORTED FROM THE ATHERTON REGION OF NORTH QUEENSLAND

Paul Nagle

Blakers et al. (1984) report unconfirmed sightings of the Yellow-legged Flycatcher *Microeca griseoceps* in the Atherton region of North Queensland. During a recent bird banding expedition I set up my nets on the edge of the upland rainforest not far from Majors Mountain National Park and near Lawyer Creek, 5 km south-east of Ravenshoe (17°38'S, 145°31'30"E, elevation 960 metres).
This area forms a buffer between the notophyll vine forest of Majors Mountain N.P. and the open savannah woodlands to the west of Ravenshoe. The dominant vegetation in this buffer is Carbeen *Eucalyptus tesselaris* with an understory of smaller eucalypts, casuarinas and a wide variety of shrubs.

An inspection of one of my nets at about 1500 hr yielded a small yellow-breasted robin-type bird. I extracted it from the net thinking I had trapped a Pale-yellow Robin *Tregellasia capito*. When I took it into the sunlight, I examined it more closely and discovered that it had certain features which were not consistent with Pale-yellow Robins I had caught before nor with the descriptions given in my copy of Slater (1975). What really struck me about this bird were its distinctly bright yellow legs, its grey head and white throat and the fact that its lower bill was lighter in colour than its upper bill. I concluded that the bird I had caught must be a Yellow-legged Flycatcher. Independent confirmation of this would be useful.

REFERENCES

BLAKERS, M. DAVIES, S.J.J.F. & P.N. REILLY. 1984. *The Atlas of Australian Birds*. Melbourne : Melbourne University Press.

SLATER, P. 1975. *A Field Guide to Australian Birds*. Vol. 2, Passerines. Adelaide : Rigby.

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ANIMALS USING THE INCUBATION MOUNDS OF THE AUSTRALIAN BRUSH-TURKEY

DARRYL JONES

INTRODUCTION

The incubation mounds of megapodes (mound-building birds) are among the largest constructions produced by animals. In Australia, the mounds of the Australian Brush-turkey *Alectura lathami* average 2.5-4 m in diameter and comprise up to four tonnes of soil and leaf-litter (Vleck, Vleck and Seymour 1984). This huge amount of moist, warm organic matter is also very suitable for a wide variety of insects and micro-organisms to feed and reproduce in (Frith 1962). These organisms in turn attract animals, other than the mound-owners, to the mound to feed.

Here, I describe some of the larger species which used the incubation mounds of Brush-turkeys at Mt. Tamborine, south-east Queensland (153°11'E,27°55'S).

METHODS

As part of a study of the reproduction of the Australian Brush-turkey (Jones 1987), the incubation mounds of the species were investigated at three sites at Mt. Tamborine during three breeding seasons: 1983-84, 1984-85 and 1985-86. A full description of the sites is given in Jones (in press). Each was in sub-tropical rainforest, with a prominent shrub layer of Lantana *Lantana camara*.

Information on use of mounds by animals was obtained from : (1) hide-based observations of mounds during the early morning (36 mounds were watched for a total of 574 hours); (2) weekly visits to all mounds constructed during the season (a total of 97 mounds for all years); and (3) excavations of all mounds which were used as incubators (a total of 43 mounds for all years). These successful mounds were not excavated until all eggs had hatched.

RESULTS AND DISCUSSION

Table 1 shows the frequency with which five vertebrate and one large insect species were detected using mounds.

TABLE 1

Percentage frequency of use of incubation mounds of Australian Brush-turkeys by other species and the method used to detect them. The methods of detection were: (1) hide-based observations (n=36 mounds); (2) weekly visits to mounds (n=97 mounds); and (3) excavations of successful mounds (n=43 mounds).

Species	% of mounds used	Method of detection
Rhinoceros Beetle (Dynastinae)	12	3
Land Mullet *Egernia major*	15	2
Long-nosed Bandicoot *Perameles nasuta*	98	2
Grey Fantail *Rhipidura fuliginosa*	4	1
Pale-yellow Robin *Tregellasia capito*	8	1
Satin Bowerbird *Ptilonorhynchus violaceus*	6	1

There was no evidence that Brush-turkeys were affected adversely by any of these species. None appeared to visit mounds to predate eggs or chicks, and none of these were challenged by the adult Brush-turkeys. Most confined their activities to the surface layers of the mounds. The sole exception to this was the Rhinoceros Beetle (family Dynastinae). This large beetle was commonly unearthed at all depths but especially at the level at which eggs had been layed (mainly between 45 and 65 cm). Large numbers of the droppings of these beetles were found among the shells of Brush-turkey eggs during my excavations. It is unlikely, however, that the beetles were involved in feeding on the eggs as no insects were present within the mound during the incubation period, the temperatures being too high (33° - 36°C) for most species. Moreover, it is unlikely that either adult or larvae are able to penetrate the shells of unhatched eggs. The presence of the species was probably due to their being attracted to the large shell membrane left behind after hatching.

A large skink, the Land Mullet *Egernia major* was frequently found during weekly visits to mounds, usually under the upper

layers of the mound to a depth of about 15 cm. Both solitary adults and pairs of this lizard were found in mounds, but no young were detected. It is unlikely that they were using the mounds for breeding. More likely, they were seeking the heat of the mound as an alternative to sun-basking as a method of increasing body temperature.

The most common user of mounds was the Long-nosed Bandicoot *Perameles nasuta*. This species left its characteristic conical feeding holes in 98% of the mounds in the study site. These holes were found in all mounds not maintained daily by the male owner of the mound. The bird's regular maintenance activities would cover any holes and the presence of Bandicoot holes was a useful indicator of the level of attendance by male Brush-turkeys at their mounds.

The three bird species (Grey Fantail, Pale-yellow Robin and Satin Bowerbird) detected using mounds were exploiting the large numbers of insects which abounded in the surface layers. As well as gleaning from the mound itself, all of these species were observed snatching insects disturbed by the raking activities of Brush-turkeys working on their mounds. Lindsey (1979) has reported similar disturbance-feeding by the Australian Fernwren *Crateriscelis gutturalis* in association with Orange-footed Scrubfowl *Megapodius reinwardt*. These observations were made, however, while the Scrubfowl was foraging away from the mound.

In conclusion, the incubation mound of this megapode may provide a potentially valuable and concentrated source of insect foods for a variety of insectivorous species. In addition, the heat produced by the decomposition of the organic matter in the mound may provide a covenient method by which reptiles such as the Land Mullet may increase their body temperature.

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REFERENCES

Frith, H.J. 1962. *The Mallee-fowl.* Sydney : Angus and Robertson.

Jones, D.N. 1987. *Behavioural ecology of reproduction in the Australian Brush-turkey Alectura lathami.* PhD Thesis, Griffith University.

Jones, D.N. (in press). Selection of incubation mound sites in the Australian Brush-turkey. *Ibis.*

Lindsey, A.I.G. 1979. A feeding association between Fernwren and Orange-footed Scrubfowl. *Sunbird* 10(2) : 47.

Vleck, D., Vleck, C.M. & R.S. Seymour 1984. Energetics of embryonic development in megapode birds, mallee fowl *Leipoa ocellata* and brush-turkey *Alectura lathami. Physiol. Zool.* 57 : 444-456.

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BOOK REVIEW

WHERE TO FIND BIRDS IN WESTERN AUSTRALIA by Noêla Marr, 1986. Kangaroo Press : Kenthurst. Pp.112, col. pl.16. 212 x 135 mm. $12.95.

There are many unknowns in planning a bird trip. Usually, you know where you are going and a few of the special birds you want to see. Most of this information is gleaned from the bird watcher's grapevine. Little is written down. In recent times, we have witnessed a swing away from the oral tradition: specific birding information is appearing in hard-copy available to all.

Noêla Marr's book is hard-copy for where to bird in Western Australia.

The author details forty of the more accessible places. Each entry has an accompanying map, and begins with a description of the area. You are told how to get there and the facilities that will be met. Also, accommodation at the site, and nearby, is detailed. There are helpful notes on the vegetation. The information on the birds is presented under two headings: "Birds" for some of the more interesting sightings, and "Ticks for Twitchers" for the very special, difficult birds. The birds mentioned are the "meatier" examples, but at the back of the book is a full list of birds recorded from all the forty areas.

The sixteen colour plates comprise photographs of the areas, as well as a selection of twenty-four of the birds that might be met. There is an index of botanical common names that are mentioned in the text, with their scientific names. The index for birds only includes common names.

I like the book. It will be with me when I go to WA again. With all that information in my bag, there will be less to worry about with planning.

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