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THE SUNBIRD

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WINTER MIXED-SPECIES FLOCKS AT CHARTERS TOWERS, NORTH QUEENSLAND

PETER L. BRITTON

ABSTRACT

127 mixed-species flocks were documented at Charters Towers, North Queensland during May-July in each of the years from 1985 to 1988. The function and development of flocks are discussed. Characteristics of flocks at temperate and tropical sites in Australia are compared and contrasted.

INTRODUCTION

The adaptive value of mixed-species flocking in birds is generally thought to involve feeding advantages, protection from predators, or both (Morse 1970). Such itinerant flocks have been reported from most parts of the world, exhibiting remarkable ecological and taxonomic variety in tropical areas (see Swynnerton 1915, Croxall 1976 and Grieg-Smith 1978). Brosset (1969) and Swynnerton (1915) explained tropical insectivorous mixed-species flocks as a method of maximizing the production of insects following beating. Gannon (1934) stressed the importance of sound in the formation of a 'loosely-connected assemblage'. Typically, flocks comprise up to a dozen species of small, passerine insectivores. In lowland Amazonian forest, 5-10 core species (mated pairs or families) are joined by 80 further species with varying degrees of regularity, entering and leaving flocks as they pass through their territories (Munn 1985).

In summary, such flocking appears to be an effective adaptation to difficult conditions (Morse 1970). Macdonald & Henderson (1977) discussed the possible significance of mixed-species flocks for migrant species foraging in unfamiliar and locally depleted areas. Bell (1986) recorded migratory parasitic cuckoos in forty February-September mixed-species flocks at 34°S in New South Wales. During autumn and winter, cuckoos were seen more often in such flocks than out of them, and Fan-tailed Cuckoos *Cuculus pyrrhophanus* certainly modified their foraging behaviour according to whichever nuclear species they were following.

In contrast, Bell (1983) failed to record a parasitic cuckoo in 300 mixed-species flocks in New Guinea.

The few detailed Australian studies have involved temperate sites at about 34-35°S, where flocks have been observed in all months, with reduced participation in spring (Bell 1980, 1986; Sedgwick 1949, Gannon 1934). Thornbills *Acanthiza* spp. are significant at these temperate sites, and Gannon (1934) regarded them as 'primary association formers' with a special role at the centre of an association. In his comparison of temperate and tropical avifaunas in the Americas, Karr (1971) noted that populations of many tropical species are far more mobile than in temperate regions; and the mixed-species flock is essentially a winter phenomenon at higher latitudes in the Northern Hemisphere (Morse 1978).

Sedgwick (1949) noted that "in northern Australia, where the genus *Acanthiza* is either absent or poorly represented, I have no recollection of having seen a typical mixed association". A 'bird wave' at 16°35'S in Western Australia (Sedgwick 1988) involved scores of White-winged Trillers and Black-faced Woodswallows, closely followed by Jacky Winters, Weebills, Willie Wagtails, Varied Sittellas and various other species (see Table 1 for scientific names). Hall (1974) refers to "a party some fifty in number, moving through trees together and keeping fairly high" at 18°S in Western Australia, including White-winged Trillers, Black-faced Woodswallows, White-breasted Woodswallows *Artamus leucorynchus*, Black-faced Cuckoo-shrike and an unidentified cuckoo *Chrysococcyx* sp.. Black-faced Woodswallows were likewise significant in two regions of northern Australia documented by Garnett & Crowley (1994, 1995).

METHODS

The 127 mixed-species flocks detailed in Table 1 were observed in semi-arid country at 300m asl, close to Charters Towers (20°05'S, 146°16'E), during May-July in each of the years from 1985 to 1988. Other flocks noted in other months and eight other years are not included here. All flocks were observed in somewhat degraded wooded grassland dominated by ironbarks, box-gums and introduced Chinee Apple *Ziziphus mauritiana* and Rubber Vine *Crypostegia grandiflora*.

A vehicle driven at less than 60km/h, before 0800h or after 1540h, was stopped whenever passerines were seen close to the road. There are four criteria for membership of a mixed-species flock: at least four species involved; all members foraging within about 20m of an individual of another species; individuals stay together for at least 7 minutes; and flock members move at least 30m in the same general direction. Similar criteria apply to a further sixteen flocks in semi-arid country at 27-28°S, between Dalby and Thargomindah. These data from southern Queensland, obtained during the period 23 June to 2 July 1994, are compared with the Charters Towers flocks. With few exceptions, data involving associations

of fewer than four species have not been retained. They are ignored in this paper.

TABLE 1. Composition of 127 mixed-species flocks at Charters Towers.

		Number of flocks (%)	Number of individuals per flock	
			Range	Mean
Willie Wagtail	*Rhipidura leucophrys*	87	1-7	2.7
Striated Pardalote	*Pardalotus striatus*	85	1-13	3.1
Rufous Whistler	*Pachycephala rufiventris*	77	1-9	2.7
Weebill	*Smicrornis brevirostris*	75	1-12	3.1
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	71	1-16	5.0
Black-faced Woodswallow	*Artamus cinereus*	66	2-18	8.8
Singing Honeyeater	*Lichenostomus virescens*	58	1-8	2.0
Double-barred Finch	*Taeniopygia bichenovii*	50	2-32	10.7
White-winged Triller	*Lalage suerii*	46	1-35	6.8
Jacky Winter	*Microeca fascinans*	40	1-4	1.7
Grey Fantail	*Rhipidura fuliginosa*	37	1-5	1.8
Varied Sittella	*Daphoenositta chrysoptera*	35	2-7	4.1
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	30	1-8	2.1
White-throated Gerygone	*Gerygone olivacea*	20	1-4	1.2
Rufous Songlark	*Cincloramphus mathewsi*	11	1-3	1.4
White-throated Honeyeater	*Melithreptus albogularis*	7	1-2	1.3
Restless Flycatcher	*Myiagra alecto*	7	1-2	1.4
Mistletoebird	*Dicacum hirundinaceum*	7	1-2	1.1
Striped Honeyeater	*Plectorhyncha lanceolata*	6	1-2	1.4
Little Woodswallow	*Artamus minor*	3	4-10	6.3
Little Friarbird	*Philemon citreogularis*	3	2-6	3.3
Crimson Chat	*Epthianura tricolor*	2	2-40	15.3

Single birds of the following species were also noted (number of flocks in parentheses): Pallid Cuckoo (1), Black-eared Cuckoo (1), Red-backed Kingfisher (4), Western Gerygone (4), Brown Honeyeater (2), Red-capped Robin (2), Grey Shrike-thrush (1), Leaden Flycatcher (1) and Grey Butcherbird (1).

RESULTS

There were many common features in the 127 flocks recorded although they varied greatly in both size and composition. Four species were present in 75% or more of the flocks (Table 1). As many as 83 individuals and 15 species were involved, although 73% of flocks involved 11-45 individuals and 66% of flocks

involved 6-10 species. Only fifteen of the thirty-one species in Table 1 were present in more than 10% of flocks and the mean number of individuals per species was 4.22.

Of the twelve 'core' species, recorded in 35% or more of winter flocks (Table 1), only the Grey Fantail is absent at other seasons. Some species are apparently resident, but Willie Wagtail, Rufous Whistler, Singing Honeyeater, White-winged Triller and Jacky Winter are far more numerous in winter. Data from North Queensland in Wieneke (1988), Taplin (1991) and Storr (1984) show that populations of many passerines are augmented by non-breeding winter visitors, presumably from southern Australia. Data in Blakers *et al.* (1984) are not supportive of any large scale movements for either Singing Honeyeater or Jacky Winter. Their Reporting Rates show that Striated Pardalote and Black-faced Cuckoo-shrike numbers increase in Queensland in winter; Varied Sittella is said to have local nomadic movements in the non-breeding season; while a Yellow-rumped Thornbill flock occupies a territory in the non-breeding season, and they are joined by other species to form mixed flocks in this territory.

Some species are extraordinarily irruptive. Flocks of 15-65 White-winged Trillers were frequent in 1988 (Britton 1990), and 1985 was exceptional for extra-limital Red-capped Robins, Crimson Chats and Orange Chats *Epthianura aurifrons* in numbers (Niland 1986). Variation from year to year is far less apparent with most 'core' species and it is significant that most of these lack breeding records from north of 20°S in Blakers *et al.* (1984). The modal egg-laying period in this northern climatic zone is September-February (Storr 1984, Lavery *et al.* 1968, Lavery 1986), and species such as Yellow-rumped Thornbill, Striated Pardalote, Black-faced Woodswallow, Weebill and Varied Sittella are probably local breeders. Mixed-species flocks have been observed at Charters Towers throughout the year, but they are not prominent during the warm October-March period.

Data on flock size and composition show that flock development involves the addition of more species as well as more individuals of species already present. The extremely significant correlation coefficient of 0.81 for number of individuals and the mean number of individuals per species suggests that more individuals of species already present is especially important in terms of larger flock size. A coefficient of 0.68 for number of individuals and number of species is also significant ($p<0.01$), however, so larger flocks involve more species.

The extent to which species associate together is measurable using Cole's (1949) coefficient of association. This association is extremely significant ($X^2 = 25.2$) for White-winged Triller and Black-faced Woodswallow, and it is significant for Grey Fantail/Rufous Whistler ($p<0.05$) and Black-faced Cuckoo-shrike/Jacky Winter ($p<0.01$). There is some evidence of association in several other pairs,

especially Grey Fantail/White-throated Gerygone and Varied Sittella/ Yellow-rumped Thornbill ($0.05<p<0.10$ for both pairs).

More individuals of species already present is especially important in terms of larger flock size. According to Blakers *et al.* (1984), Varied Sittella lives in groups (generally of 2-12 birds), Yellow-rumped Thornbill lives in territorial groups, and Black-faced Woodswallow exhibits clustering behaviour. It is likely, then, that recruitment of these species to a mixed-species flock will involve groups rather than individuals. The extreme association of Black-faced Woodswallow and White-winged Triller is borne out by a very significant correlation coefficient ($p<0.001$) for the number of each species in a flock. Surprisingly, perhaps, flock size for Varied Sittella ($p<0.01$) and Yellow-rumped Thornbill ($p<0.05$) does indeed vary with overall flock size, rather than being determined by the size of a particular flock of either species in a particular area.

There is reason to believe that mixed-species flocks occur in many regions and habitats in Australia, although their characteristics no doubt vary greatly from place to place. Any comparison involving Charters Towers and temperate sites in Queensland is likely to be instructive, and to this end an effort was made to document mixed-species flocks at 27-28°S during the period 23 June to 2 July 1994. Table 2 includes the fourteen species recorded in at least two flocks. Means of 16.2 individuals and 5.56 species in these sixteen flocks are significantly less than 32.8 individuals and 8.33 species at Charters Towers ($p<0.01$). Red-capped Robin *Petroica goodenovii* and Willie Wagtail were present in eleven and ten flocks, respectively. Thornbills, already noted as a prevalent component of mixed-species flocks further south, were found in six (Chestnut-rumped Thornbill *Acanthiza uropygialis*), four (Yellow-rumped Thornbill) or nine (*Acanthiza* sp.) of these sixteen flocks. Associations involving Southern Whiteface *Aphelocephala leucopsis*, Red-capped Robin, both thornbills and various other species are mentioned by Hall (1974), including Willie Wagtail "joining bird parties and trying to rob smaller birds such as *Acanthiza* of food". Regrettably, most such observations are not identified by location or latitude.

DISCUSSION

There has to be an early or embryonic stage in the formation of a mixed-species flock and any such species or characteristics presumably continue as the flock grows. Pied species or a blend of brown species and black species are favoured hypotheses (Greig-Smith 1978, Diamond 1987), although Gannon (1934) argued that species such as Eastern Spinebill *Acanthorhynchus tenuirostris* and Grey Fantail "seem to be attracted immediately towards the Thornbills, and, with their louder calls, attract birds from a larger area than the Thornbills would by themselves". Yellow-rumped Thornbills were present in 71% of flocks at Charters Towers. It is possible that their persistent vocalisations or their habit

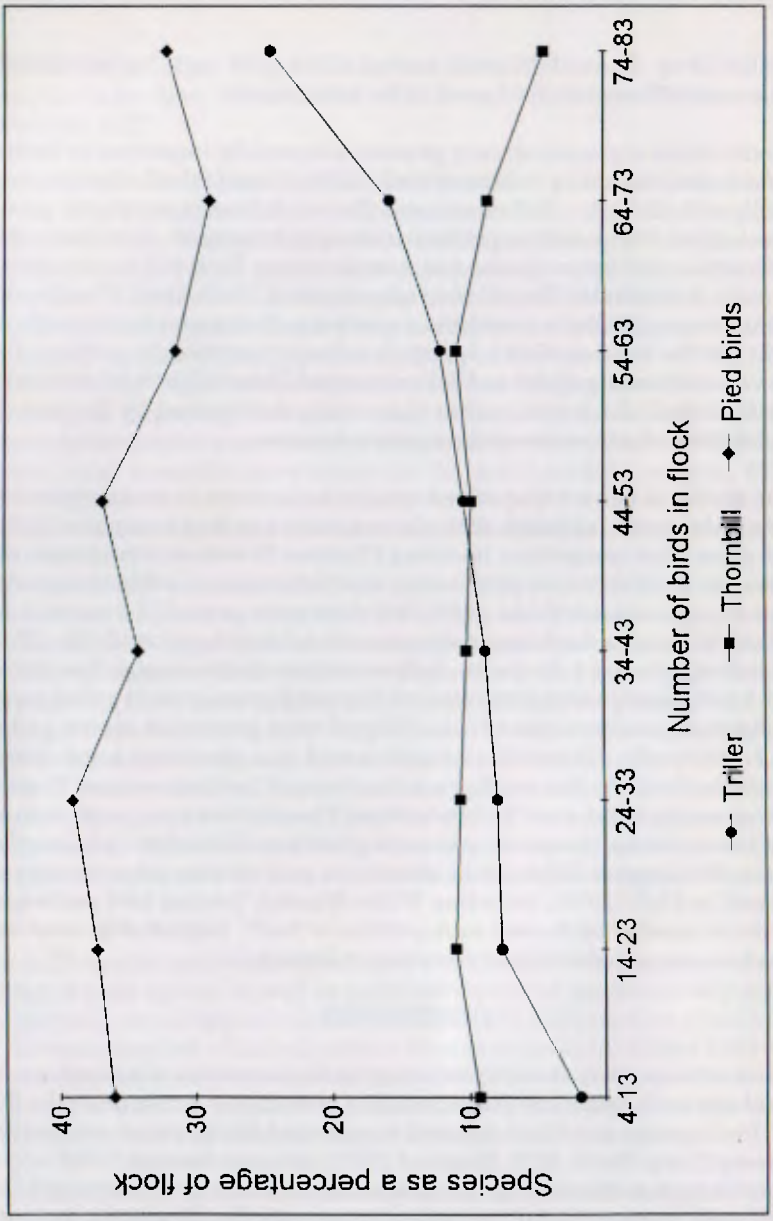

Fig. 1. White-winged Triller, Yellow-rumped Thornbill and four pied species as percentages of the number of individuals in flocks of different sizes at Charters Towers.

TABLE 2. Composition of 16 southern Queensland mixed-species flocks. Species listed were present in two or more of the flocks.

	Number of flocks %	Number of Individuals per flock Range	Mean
Red-capped Robin	69	1-4	2.1
Willie Wagtail	63	1-2	1.2
Southern Whiteface	44	3-12	6.0
Rufous Whistler	44	1-3	2.1
Black-faced Woodswallow	44	2-9	4.7
Chestnut-rumped Thornbill	38	1-3	2.0
Singing Honeyeater	38	1-4	2.2
Yellow-rumped Thornbill	25	3-9	6.8
Weebill	19	2-3	2.3
Crested Bellbird	19	2	2
Grey Fantail	19	1-6	3.3
Striated Pardalote	13	2	2
Western Gerygone	13	1-2	1.5
Varied Sittella	13	2-5	3.5

of feeding in small, mobile groups on patches of bare ground are important ingredients in the formation of flocks. In tropical Western Australia, a 'bird wave' was led by scores of Black-faced Woodswallows and White-winged Trillers (Sedgwick 1988). Adult males of the latter species are indeed pied, but most White-winged Trillers at Charters Towers are apparently immature. Being present in 85% or more of flocks, Striated Pardalote and Willie Wagtail are presumably important ingredients when a flock is at this embryonic stage. Neither has a significant coefficient of association when paired with another species.

Though present in only 35% of flocks, and perhaps overlooked to some extent, Varied Sittella is included as a pied species along with Willie Wagtail, Striated Pardalote and Black-faced Woodswallow in Fig. 1. White-winged Triller and Yellow-rumped Thornbill are included in this analysis, which details the percentage of individuals of a particular species or group of species in flocks of different sizes. Garnett & Crowley (1994) noted that Black-faced Woodswallows at a Cape York Peninsula site were mobile for most of the year, appearing to travel widely around a substantial home range. When breeding they appeared

to act as sentinels and similar mixed-species flocks are quantified further by Garnett & Crowley (1995). The typical behaviour of this conspicuous species is likely to focus attention on a flock at Charters Towers or elsewhere.

One's impression of White-winged Triller at Charters Towers is of a follower rather than a leader, and this is borne out by the increasing percentage in Fig. 1. The proportion of pied birds tends to decline as flocks grow, which supports the notion that such species are basic to the development of flocks. The pattern for Yellow-rumped Thornbill in Fig. 1 is inconclusive, but a fairly consistent 10% indicates that thornbills are far less important in the formation of flocks at 20°S than they are at temperate sites.

When comparing Charters Towers data with those from southern Queensland it is striking that several species are common to the two areas, and that the feeding niches of others have equivalents. It is hoped that this preliminary analysis, involving admittedly scant data from southern sites, might prompt others to present comparative data from other temperate sites in Queensland.

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THE HABITAT VALUE OF EXTREMELY SMALL BUSHLAND REMNANTS TO BIRDS IN BRISBANE

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ABSTRACT

This study investigated the extent to which extremely small bushland remnants of the southern Brisbane region supported bird densities similar to those found either in large forest areas or in the surrounding suburbs. Nine sites were visited within each of the following three habitat categories: large remnants (> 500 ha), extremely small remnants (1-2 ha) and urban areas. Grey Fantails were abundant in the large remnants, rare in the extremely small remnants and absent from the urban sites. The abundance of Silvereyes did not differ significantly among the habitats. Spotted Turtle-Doves were seen more frequently in the urban sites than in either type of remnant. The extremely small remnants were characterised in particular by high densities of Noisy Miners, and bird densities in these remnants did not resemble those in other sites. In this respect the extremely small remnants were most similar to forest edge habitats described in other studies. Grey Fantail densities appear most likely to have been lowered as a result of aggression by Noisy Miners, and other small forest-dependent insectivores may be similarly affected.

INTRODUCTION

The loss and fragmentation of forest habitats is a major concern for the conservation and management of birds and other wildlife (Saunders *et al.* 1991). Some bird species benefit from conversion of native forest and woodland to pasture, plantation or urban areas, including native species such as the Australian Magpie, Galah and Crested Pigeon and introduced species such as the Spotted Turtle-Dove and Common Starling. Many, however, are substantially dependent on forest habitats and are unable to use or survive in the cleared areas (including species of fantail, robin, whistler, treecreeper, pardalote and various honeyeaters), while some do not appear to be either positively or negatively affected (see Howe 1986, Loyn 1985, Catterall *et al.* 1991, Catterall & Kingston 1993, Saunders 1993, and references therein).

It is hence of some importance to establish the minimum size of habitat remnant that can support forest-dependent species. Previous research in parts of rural Australia has shown that forest remnants down to about 10 ha in area contain densities of many forest-dependent birds that are similar to those in large forest areas, although these species may rarely occur in remnants of only a few hectares (Howe 1986; Loyn 1985, 1987; Barrett *et al.* 1994) The interpretation of these results has however been complicated by the fact that the very small

remnants studied in pastoral areas were typically degraded, in the sense that they lacked understorey as a result of grazing and fire management practices. Previous research in the greater Brisbane region has also found little difference in density of most forest birds within remnant bushland areas down to about 10-20 ha (Catterall & Kingston unpub.), although decreased densities of some are evident in smaller remnants of 5-10 ha (Sewell & Catterall in press). Furthermore, the composition of bird species at the edge of a large forest remnant in Brisbane was different from that in the forest interior (Catterall *et al.* 1991). Extremely small or narrow remnants might be effectively "all edge". For example, if an edge effect penetrated 30 m from the forest/suburb interface then a circular 1 ha remnant would contain only about 0.23 ha that was not "edge" habitat. The present study was designed to investigate the extent to which extremely small (1-2 ha) bushland remnants of the southern Brisbane region supported bird densities similar to those found either in large forest areas or in the surrounding suburbs.

STUDY AREA AND METHODS

Study area and study sites

The study took place in the southern suburbs of Brisbane, south east Queensland. The study area was approximately 350 km^2 in size, being bounded by Old Cleveland Road in the north, Wembley Road in the south, Beaudesert Road in the west, Ironside St. (St. Lucia) in the northwest, Mt. Petrie Road in the northeast, and the eastern edge of Daisy Hill State Forest in the southeast. There were nine sites within each of the following three habitat categories.

(1) Large remnants: areas of eucalypt forest more than 500 ha in size. Within the study area there were three large remnants: Toohey Forest in the north, Karawatha Forest in the southwest, and Daisy Hill State Forest (and adjacent bushland) in the southeast. Three study sites were located within each of these remnants, spaced at least 500 m apart.
(2) Extremely small remnants: areas of remnant eucalypt forest 1-2 ha in size, surrounded by urban development and at least 500 m from any other bushland remnant.
(3) Urban areas: moderately vegetated suburban streets.

Both large and extremely small remnants were of broadly similar tree species composition. Both had a tree canopy between 10 and 20 m tall, with canopy cover between 20% and 70%, and an understorey of small native trees, shrubs and herbs, although introduced species (mainly herbs and shrubs such as *Asparagus* spp., *Ochna* sp. and *Lantana* spp.) occurred frequently within the understorey of the extremely small remnants but were rare in the large remnants. The underlying physical nature of the sites was standardised by avoiding riparian areas (minor creeklines) and ridgetops, and selecting sites that were positioned

topographically on intermediate slopes. The extremely small remnants and urban sites were interspersed across the study area.

Data collection

At each site, an index of bird density was obtained by two observers (RE and GB) walking together along a transect of 200 m by 30 m, during a 30 minute observation period, and recording all birds seen. Each site was visited twice, once in the morning between 6:00 and 9:00 am and once in the afternoon between 3:30 and 6:30 pm, on different days, during the period 21 March to 1 May, 1995. Birds flying above 10 m were excluded from all data analyses.

While more than forty bird species were recorded during the study, most occurred at only a few sites. We chose four species that occurred at a large proportion of sites in at least one habitat (to permit statistical analyses), and for which we were also confident that identification had been consistently correct. These were Grey Fantail *Rhipidura fuliginosa*, Noisy Miner *Manorina melanocephala*, Spotted Turtle-Dove *Streptopelia chinensis* and Silvereye *Zosterops lateralis*. Differences in density of each species among the three habitat types and between the morning and afternoon sampling times were tested statistically by means of two factor Analysis of Variance (ANOVA; Zar 1984).

RESULTS

Grey Fantails were abundant in the large remnants (LR in Fig. 1) but were rare in the extremely small remnants (ESR) and absent from the urban sites (U). The ANOVA probability (*P*) values for the effect of habitat (HAB), time of day (TIME), and their interaction (HAB X TIME) are also shown in Fig. 1. The habitat effect was highly significant (*P* for HAB 0.0001). Pairwise differences between habitat means were tested with extended *t*-tests (Zar 1984), and habitats with the same letter in Fig. 1 were not significantly different, with this being consistent across the morning and afternoon. Large remnants had significantly higher densities of Grey Fantails than the other two habitats, which did not differ significantly from one another. The number of Grey Fantail sightings showed little difference between morning and afternoon (*P* for TIME 0.53).

Noisy Miners were abundant in the extremely small remnants, not seen in sites within the large remnants and rare in the urban sites (Fig. 1). There was a highly significant ($P=0.0004$) difference among the habitats; the extremely small remnants differed from the other two habitats, which did not differ significantly from one another. The number of Noisy Miner sightings showed little difference between morning and afternoon, although there was a non-significant tendency for more birds to be seen in the morning.

The abundance of Silvereyes did not differ significantly among the habitats or between morning and afternoon. The large error bars in Fig. 1 occur because the Silvereyes were seen mainly in flocks, which made their numbers very variable. Since there were no significant effects of habitat, no pairwise extended *t*-tests were done and no letters are shown on Fig. 1.

Spotted Turtle-Doves were seen frequently in the urban sites in the morning, were recorded at moderate frequencies in the urban sites in the afternoon, were rare in the extremely small remnants and were not recorded in the large remnants (Fig. 1). Since the habitat by time interaction was statistically significant (P=0.003), the effect of habitat was also tested with separate ANOVA's for morning and afternoon, and both were statistically significant (p=0.0001, p= 0.01 respectively). The results of extended *t*-tests for morning and afternoon separately are shown as the two sets of letters (upper case for morning and lower case for afternoon) in Fig. 1. The density of Spotted Turtle-Doves was significantly greater in the urban sites than in either type of remnant, at both times of day.

DISCUSSION

Most of the observed bird density differences between large forest remnants and urban areas are consistent with earlier findings in the region (Catterall *et al.* 1991). The bird densities in extremely small remnants differed from those in both the large forest remnants and urban areas, and the extremely small remnants were characterised by high densities of Noisy Miners (Fig. 1). In this respect the extremely small remnants were most similar to the forest edge habitats described by Catterall *et al.* (1991) and Hudson *et al.* (in press), which also had much higher densities of Noisy Miners and lower densities of Grey Fantails than found in the forest interior habitats. This supports the suggestion that a large proportion of the area within extremely small remnants may be essentially "edge" habitat.

While the Grey Fantail does not necessarily represent the full suite of forest-dependent species, it may be an indicator of other small foliage-feeding forest species also likely to be absent from the extremely small remnants. A further reason that this might be the case is the high density of Noisy Miners, well known for their high levels of aggressiveness towards other birds and their ability to exclude them from defended areas (see, for example, Dow 1977, Loyn 1987 and Ford 1993). Studies elsewhere in Australia have also found that remnants only a few hectares in size support elevated densities of Noisy Miners (Loyn 1987) and reduced densities of many small insectivorous bird species (Howe 1986, Loyn 1985 and 1987).

Possible causes of the relative rarity of Grey Fantails in the extremely small remnants (c.f. Saunders *et al.* 1991) could be: (1) there have been local extinctions,

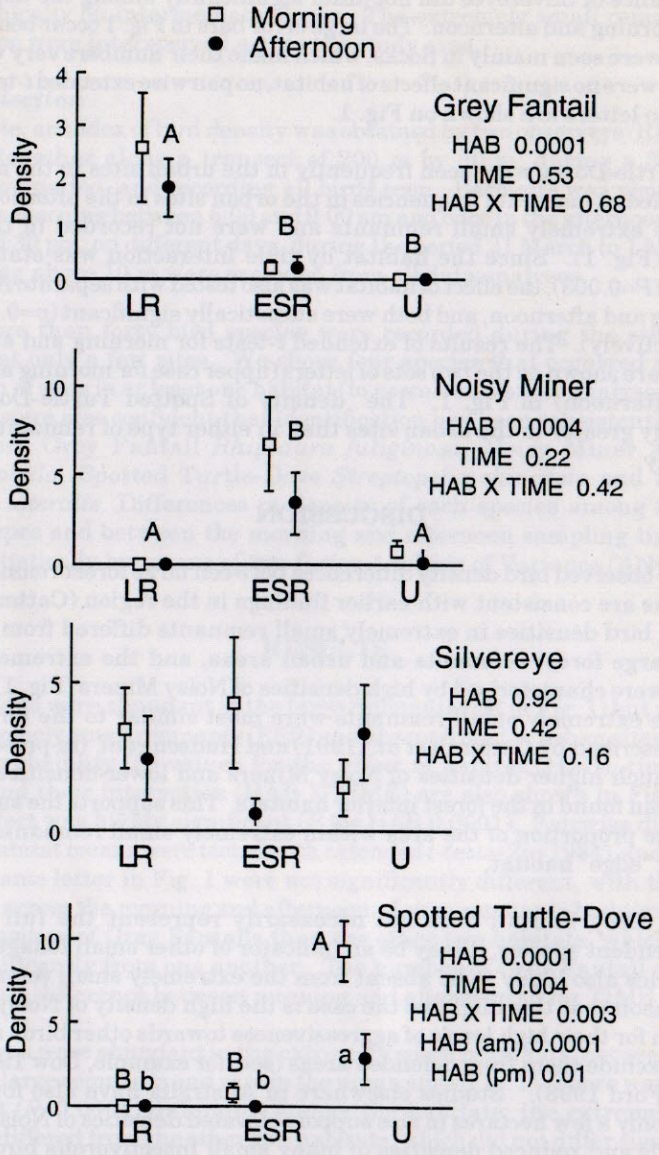

Fig. 1. Variation in bird density (means and standard errors) among the three habitats and two times of day, and results of statistical tests (see text for explanation).

commonly postulated for small remnants, resulting from random fluctuations in the balance between births and deaths; (2) there is a difference in the habitat structure or species composition associated with fragmentation, and hence inherent unsuitability of the habitat within these remnants; (3) the remnant forest area is smaller than is necessary to meet the requirements of even a single individual of the species; and (4) there have been interactions with other species (predators or competitors) which make use of the surrounding cleared habitats.

The first cause is unlikely because the Grey Fantail is a winter nonbreeding immigrant to the study region (Roberts 1979), so that individuals arriving in the region have the opportunity to choose their winter habitat area anew every autumn, and their dispersal into the smallest remnants should have been possible. The careful selection of sites, so that their vegetation structure was as similar as possible in the large and small remnants, allows the second reason to be discarded. The third possible reason cannot be ruled out, although it seems unlikely because of the Grey Fantail's generalist feeding habits and because the study took place in the nonbreeding season, when resource requirements of individuals are less. Blakers *et al.* (1984) summarised typical breeding densities in southern Australia as about 0.5-1.0 (maximum about 5) birds per hectare, whereas after breeding 7-9 per hectare were observed. Thus, areas of 1-2 ha should be able to support several nonbreeding individuals, although access to water may be a problem in some remnants. The fourth reason, interspecific interactions, could be important. In particular, densities of many small insectivorous birds within the extremely small remnants could be lowered as a result of aggression by Noisy Miners, which are probably common in the extremely small remnants because they benefit from access to the combination of resources provided at the interface between suburbs and remnant forest.

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RANGE EXTENSION OF THE CAPRICORN SILVEREYE *ZOSTEROPS LATERALIS CHLOROCEPHALA*, WITH A NOTE ON THE BIRDS OF BUSHY ISLAND

JIRO KIKKAWA

The Capricorn Silvereye *Zosterops lateralis chlorocephala* was first described from Heron Island as a species of *Zosterops* by Campbell & White (1910). It has been regarded as a subspecies of *Z. lateralis* in the Checklist (RAOU 1926). According to Mees (1969, p.87) the subspecies is confined to the Capricorn and Bunker Groups of the Great Barrier Reef, where it is known from all islands.

I surveyed the distribution of this subspecies in the southern Great Barrier Reef between 1989 and 1992 and was able to confirm the contemporary presence of resident populations on all islands of the Capricorn and Bunker Groups. In addition, I found it on Bushy Island off Mackay, which gives an extension of its known range for some 290 km in the direction of NNW from North West Island of the Capricorn Group. The late Terry Walker made surveys of birds on Bushy Island between 1984 and 1987 and recorded the Silvereye *Z. lateralis* as the only resident passerine species on the island, represented by fewer than 100 individuals (Walker 1987). I visited the island on 24 September 1992 and identified the Silvereyes there as belonging to the Capricorn race *chlorocephala*.

BUSHY ISLAND

Bushy Island (150°05'E, 20°57'S) is a coral cay of 4.5 ha in area, located 90 km east of Mackay in the Central Region of the Great Barrier Reef. The island is covered with woody vegetation consisting of *Pisonia* forest and strand shrubs of *Argusia argentea* and *Scaevola sericea*, with scattered *Casuarina* and *Pandanus* trees. It is the only wooded coral cay between Green Island (east of Cairns) and the Capricorn Group off Gladstone.

Walker (1987) found that although a large population of Black Noddies *Anous minutus* roosted on the island there was no nesting colony of seabirds on the island. The most unusual presence on the coral cay, to be revealed by its raucous calls upon landing, was the Orange-footed Scrubfowl *Megapodius reinwardt*, of which Walker (1987) recorded three pairs and seven sand nesting mounds. The species noted during my visit are listed in Appendix 1.

METHODS

Eleven Silvereyes were captured by mist-net at their foraging sites during the day. Mass, measurements and a blood sample for DNA studies were taken from each bird. Nine of them were banded and released after measurement and two were collected for tissue samples. The standard measurements included wing length (the right wing folded parallel to the body axis and measured unstretched),

tail length (from the base of the central pair of rectrices to the tip of the longest feather), tarsus length (the right leg in flexed position) and bill length (exposed culmen). Birds were weighed in bags using a 50 g Pesola spring balance. The mass was not standardised for time of day although each bird was kept in a holding cage for 10 to 30 minutes before weighing. Plumage and leg colours were noted for each bird.

RESULTS AND DISCUSSION

There were about 30 Silvereyes on the island foraging in loosely integrated flocks. All birds observed were of island form and no mainland birds were noted. Both their plumage colours and measurements taken were within the range of variation known in the Heron Island population (Kikkawa 1970). All had the yellow-green head, grey upper back and breast and bright yellow throat. The undertail coverts varied between grey and yellow. Three out of eleven birds had some tail feathers moulting and one of the birds collected had enlarged testes. The leg colours in conjunction with measurements indicated that at least six birds out of eleven were first year birds (legs black or dark grey). Morphometric measurements reveal that the Bushy Island birds are much larger than those of the mainland race that drift to southern Great Barrier Reef islands during migration (see Kikkawa 1970) but slightly smaller (except in bill length) than Heron Island birds (Table 1). This latter observation is consistent with the hypothesis (Kikkawa 1973) that there is a cline of the island race along the Great Barrier Reef. However, except for the wing length, the differences between the two island populations were not significant.

TABLE 1. Comparison of Capricorn Silvereye measurements between Bushy and Heron Islands. Heron Island birds were sampled in July 1990.

		Mass		Wing		Tail		Tarsus		Bill	
	n	mean (g)	s	mean (mm)	s	mean (mm)	s	mean (mm)	s	mean (mm)	s
Bushy Island	11	13.6	0.87	62.3*	1.66	47.2	2.25	19.80	0.45	11.81	0.48
Heron Island	34	13.9	1.24	63.6	1.56	48.1	1.47	20.19	0.69	11.57	0.40

* Significantly different (t=2.31, p<0.05) from the mean of the Heron Island sample.

The Silvereye is the only bird species known to have been differentiated morphologically on the islands of the Great Barrier Reef (Kikkawa 1976). Mees (1969, p. 324) considered that this is a very young subspecies and its large size has developed on small islands. He thought, however, that the *Z. lateralis* populations found on some continental islands north of Mackay belonged to the

mainland race *Z. l. ramsayi* (Mees 1969, p. 83). Walker (1987) noted breeding populations of Silvereyes on some continental islands in the Mackay-Bushy Island region but did not specify either the islands or the race of Silvereyes inhabiting them. Further to the north, among the Cumberland Islands, T.W. Schoener (pers. comm.) noted presence or absence of Silvereyes on various islands (see below), which suggests that their distribution on small continental islands is irregular.

Silvereyes present

Whitsunday Group:

Langford Is. (148°52'E, 20°05'S), NW of Hook Island;
Black Is. (148°53'E, 20°05'S), NW of Hook Island;
Delaraine Is. (149°09'E, 20°10'S), E of Border Island.

Silvereyes absent

Whitsunday Group:

Mid Molle Is. (148°50'E, 20°15'S), N of South Molle Island;
Planton Is. (148°51'E, 20°16'S), South Molle Island Group;
Denman Is. (148°51'E, 20°17'S), South Molle Island Group.

Lindeman Group:

Cole Is. (149°00'E, 20°26'S), NW of Lindeman Island;
Seaforth Is. (149°02'E, 20°28'S), S of Lindeman Island.

Sir James Smith Group:

Ingot Islets (North Islet)(149°09'E, 20°42'S), S of Goldsmith Island.

It is not known if the populations found on some small Whitsunday islands belong to the mainland race or the island race. If they belong to the island race *chlorocephala*, so far known only from wooded coral cays, the Capricorn Silvereye may consist of metapopulations occupying many islands of the Great Barrier Reef, permitting the clinal gene flow right up to the southern limit of the Pale White-eye *Z. citrinella*. Further studies are needed to clarify the status of Silvereyes on the Central and Northern Regions of the Great Barrier Reef.

ACKNOWLEDGEMENTS

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APPENDIX 1. Species recorded on Bushy Island on 24 September 1992.

Time: 0815 (high tide) - 1800. Weather: fine, calm sea.

Orange-footed Scrubfowl *Megapodius reinwardt*	3 or 4 pairs
White-faced Heron *Egretta novaehollandiae*	20+
Eastern Reef Egret *Egretta sacra*	10+
Osprey *Pandion haliaetus*	1
Grey-tailed Tattler *Heteroscelus brevipes*	20+
Ruddy Turnstone *Arenaria interpres*	20+
Pied Oystercatcher *Haematopus longirostris*	3+, 1 nest with 2 eggs just above highwater mark
Silver Gull *Larus novaehollandiae*	6
Black Noddy *Anous minutus*	1 found dead, none in trees
Forest Kingfisher *Todiramphus macleayii*	1
Sacred Kingfisher *Todiramphus sanctus*	2+
Black-faced Monarch *Monarcha melanopsis*	1
Leaden Flycatcher *Myiagra rubecula*	1
Torresian Crow *Corvus orru*	2
Silvereye *Zosterops lateralis chlorocephala*	about 30

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LAUGHING KOOKABURRA *DACELO NOVAEGUINEAE* PREDATION ON A RED-BACKED BUTTON-QUAIL *TURNIX MACULOSA*

CLIFFORD B. FRITH and DAWN W. FRITH

Although Laughing Kookaburras *Dacelo novaeguineae* are widespread and common, and their diet appears well known, few records exist of their taking adult birds as prey. For example, the diet of Laughing Kookaburras studied near Melbourne in Victoria consisted of 35% reptiles, 32% insects, 15% earthworms, 8% crayfish, 7% foods made available by people and 1% rodents (Parry 1970). Writing of the food of the Laughing Kookaburra, Forshaw & Cooper (1985) stated that "There are records of kookaburras taking small birds, especially nestlings, but the incidence of this is minor, and it probably occurs at a time of scarce food supply." In a recent monograph of the kingfishers and some related birds, Fry *et al.* (1992) do not add significantly to this. Shields (in Strahan 1994) notes that Laughing Kookaburras will take small birds from mist nets, often becoming captured therein themselves. He also reports seeing a Laughing Kookaburra deprive a large flock of Grey Currawongs *Strepera versicolor* of a wounded European Starling *Sturnus vulgaris* they were attempting to kill. The Kookaburra grasped the Starling by the head, bashed it twice against the ground, and then flew off with it.

Whilst driving along a narrow dirt track that is Pei Road at Butcher's Creek near Malanda, Atherton Tableland, north Queensland at 1340 h on 18 September 1995, we noted a Laughing Kookaburra perched atop a one metre tall timber fence post beside the road. It held something large and bulky in its bill. Stopping the car some 15 m away, and using field glasses, we could clearly see that the object was an adult Red-backed Button-quail *Turnix maculosa*. This button-quail species is very familiar to us for we often see it foraging at the grassy edge of Pei Road. It appeared to be freshly dead. After a minute or so the Kookaburra flew down to a small boulder several metres from its fence post perch and there beat the Button-quail upon the rock two or three times in typical kingfisher fashion. At this point a Pied Currawong *S. graculina* flew in to land on the ground within a metre of the Kookaburra, causing the latter to fly off with its prey in its bill. The Currawong followed it closely. We watched both birds until out of sight.

Pei Road at the point where this event took place is a dirt track bisecting extensive open cattle pasture with a barbed wire fence on timber posts either side and long grass (attractive to button-quails) on the road reserve and road edge. The pastures are bordered by rainforest about 0.5-1 km from where this event occurred. Vehicular traffic on this track is infrequent and although it is possible the Button-quail was injured by traffic prior to its capture by the Kookaburra we consider this to be an unlikely event. Another possibility is that the Button-quail had been damaged in some other way. For example; a freshly

dead Brown Quail *Coturnix ypsilophora* was found on this same stretch of road with one wing impaled on a strand of the barbed wire fence (see Figure 1).

As wild kingfishers, unfamiliar with people and food made available by them, do not appear to respond to motionless, dead animals as prey to be eaten as carrion (pers. obs.), it must be considered unlikely that the observed Laughing Kookaburra did so, particularly as the Button-quail appeared fresh and had no ants upon it. The most likely scenario would appear to be that the Kookaburra, using the convenient road-edge fence posts to hunt from, took the live Button-quail as prey in the normal way. We consider it very likely that the Button-quail was alive, if not fit and well, when taken and, Currawong permitting, would have been eaten by the Kookaburra. *Pace* Forshaw & Cooper (1985), we believe it is as likely that the Laughing Kookaburra might opportunistically attempt to take small birds, of any age under favourable circumstances, than it is they do so only when other food is scarce.

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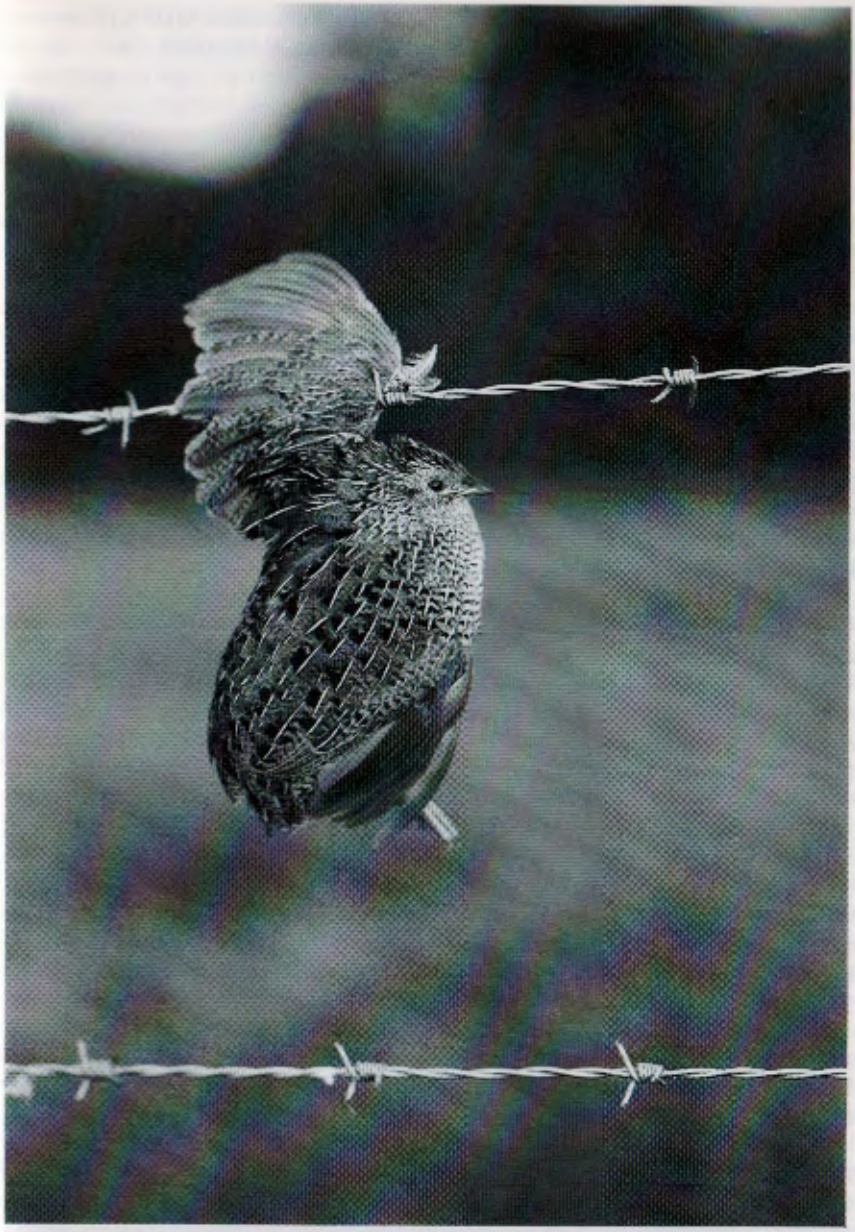

Figure 1. An adult Brown Quail *Coturnix ypsilophora* that died as a result of impaling one wing on a barbed wire fence strand in flight; near Malanda, north Queensland.

OTHER OCCUPANTS OF WEDGE-TAILED SHEARWATER BURROWS: ADDITIONAL OBSERVATIONS

P. K. DYER

INTRODUCTION

Amongst other occupants reported in Wedge-tailed Shearwater *Puffinus pacificus* burrows, Dyer (1992) recorded a Buff-banded Rail *Rallus philippensis* chick in a burrow on North West Island, Capricorn Group, in the southern section of the Great Barrier Reef. Although Hindwood *et al.* (1963) state that it is common for Buff-banded Rails to shelter in petrel burrows, observations by P.Dyer, G.Hill and J.Rosier at Heron Island indicate that this probably occurs, if at all, only in uninhabited Shearwater burrows at that location. At Heron Island, on many occasions, Buff-banded Rails which had entered occupied burrows were observed making hasty retreats accompanied by frenzied Shearwater vocalisations. It appeared that the resident Shearwaters were in no way inclined to share their burrows. The chick recorded in the burrow on North West Island (Dyer 1992) was alone in an empty burrow and it was assumed to have been abandoned or that the parent/s had been disturbed by researchers.

Prior to the current observations of Buff-banded Rails in Shearwater burrows at Raine Island, and apart from the single observation of a Rail chick in a burrow on North West Island, the author had not seen any Buff-banded Rails within the confines of Wedge-tailed Shearwater burrows, despite six years of research using a 'burrowscope' in various locations on the Great Barrier Reef and on North Stradbroke Island.

OBSERVATION OF BUFF-BANDED RAILS IN OCCUPIED SHEARWATER BURROWS

In December 1995 the Raine Island Corporation's research team visited Raine Island, approximately 170km southeast of the tip of Cape York Peninsula, in the far northern Great Barrier Reef, to carry out research into the island's history, reptiles, and avian ecology. The author's primary purpose was to investigate the breeding status of the island's Wedge-tailed Shearwater colony. The contents of more than 200 Wedge-tailed Shearwater burrows were viewed via a burrowscope which reveals the contents of burrows on a monitor placed beside burrow entrances (Dyer & Hill 1991).

On 11 December 1995 the burrows in the middle of the northern vegetated section of Raine Island were inspected. A different Buff-banded Rail was disturbed when the burrowscope was inserted in two of these burrows. The two Rails had apparently been sheltering from the extreme heat, making use of the shade of the separate burrow entrances. Contrary to observations on Heron Island, where Rails left the vicinity on disturbance, the two Rails seen in the

burrows on Raine Island ran to the burrow chambers located at the end of each burrow. Each of the two burrows was occupied by a Wedge-tailed Shearwater incubating an egg. In neither case did the resident Shearwater object to this intrusion and, in one case, the Shearwater appeared to assist the Rail that had entered its burrow by lifting its wing and allowing easy access to the back of the burrow chamber. The Rails and Shearwaters showed no further agitation at the intrusion of the burrowscope nor any animosity toward each other. Each remained calm and stationary in the burrow chamber, with the Rails virtually hidden from view by the Shearwaters. A small number of Shearwaters seem to be alarmed by the burrowscope and this agitation is apparent when birds peck at the burrowscope or try to move away from it. In most cases, as in these two cases on Raine Island, Shearwaters simply look at the burrowscope or pay it no attention at all (Dyer & Hill 1991).

INTERPRETATION

The Buff-banded Rail, reported as "secretive and wary but not shy" (Marchant & Higgins 1993) was recorded as occupying petrel burrows on Raine Island as early as 1917 (MacGillivray 1917). Nevertheless the current observations of Rails in burrows occupied by Shearwaters were surprising given the reaction of Shearwaters on Heron Island when Rails entered occupied burrows.

As Rails regularly scavenge food from uncovered waste baskets in research cabins on Heron Island, and as they prey on unattended eggs and small chicks (Warham 1961, King 1986), there is a general opinion, on Heron Island, that Rails may scavenge for Shearwater eggs in burrows. This is supported by observations of Rails entering and leaving Shearwater burrows, but it has not been confirmed in the literature. If Shearwater eggs are predated by Rails the apparent acceptance of, or indifference to, the Rails by the Shearwaters as reported here is difficult to interpret. The interaction between the two species could be similar to that observed between Land Hermit Crabs *Coenobita perlatus* and Wedge-tailed Shearwaters on Heron Island (Dyer 1992). Land Hermit Crabs and Buff-banded Rails could benefit by the protection from heat that burrows afford but a negative impact on Wedge-tailed Shearwater breeding success is possible.

The intense research performed with the burrowscope in the Capricorn Group revealed no similar observations of interspecific interactions between Shearwaters and Rails inside burrows. Given the fact that Rails appeared to be most unwelcome in occupied burrows on Heron Island, it appears that the described interaction between Rail and Shearwater on Raine Island, though instigated by observer disturbance, may be influenced by habitat or local environmental criteria. Perhaps the extreme heat and relative lack of shade on Raine Island is sufficient to explain the different findings between locations. No adult Rails have been observed inside burrows in the Capricorn Group which suggests that earlier sightings of Rails entering or leaving burrows could, indeed, have been

related to scavenging trips. Alternatively, sheltering in burrows may be more common but not witnessed because of observer disturbance. If this is so it could, in part, account for the fluctuation in numbers of Rails recorded on islands (Kikkawa 1970), which is not necessarily related to movement (Walker 1986).

The two records presented here could simply represent exceptional *ad hoc* behaviour which results from disturbance. Even so this response to disturbance is different from that observed at other locations. The reasons for the aggressive behaviour of Shearwaters towards Rails on Heron Island, but seemingly protective behaviour or indifference on Raine Island, remains to be explained.

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BOOK REVIEW

BIRDS OF QUEENSLAND'S WET TROPICS AND GREAT BARRIER REEF. Lloyd Nielsen. Gerard Industries, Bowden, South Australia, 1996, 331 pages, numerous colour illustrations, $29.95

For those who are familiar with this author's previous *Birds of Lamington National Park and Environs - A Guide's Guide*, this latest publication is an extension of that idea, utilising the same unique format but in a much more refined and extravagant production. For example, the illustrations are accurately executed in colour and much larger. A band of colour at the top of each page provides a key for each relevant section, effectively promoting 'user-friendliness'. A further improvement is that the illustrations are situated at the outer edge of each page rather than being aligned to the right, for ease of referral in the field.

This compact book has an ivory linen-textured cover and feels good to hold. The front features an illustration of the Buff-breasted Paradise-Kingfisher flying through an oval of muted-green rainforest, making an attractive contrast. It is essentially a field-guide with a difference. Furnishing a wealth of information to all birdwatchers, it is particularly useful for beginners because it provides strategies to readily identify species via predominant features or behaviour.

The book is divided into three main areas: Key Features, Where To Find Each Species, and Best Bird-Watching Areas. The first of these functions in the following manner. Once the observer has noted approximate size, and any special feature or behaviour, there is a list of headings provided, and the user is directed to the Key Features, indicated by colour-coded pages where "Possibilities" are displayed.

Assume for example, that an observer had seen a Grey-headed Robin and wished to identify it. Obviously too many birds have grey heads, but another feature noted might be the white bars on the wing or white wing patches in flight. A behaviour observed might be the fact that it perches sideways on tree trunks. Let us, however, follow the " wing" option through."Wings" is listed alphabetically in the key, and "pale or white wing patches" refers the user to the range of possibilities on pp. 109-110. All birds are pictured along with descriptions and maps. Scanning through these two pages would lead the observer to the Grey-headed Robin on p. 110, where, upon reading the succinct description, there should be no room left for uncertainty. This particular species can also be found listed under "Birds that perch sideways on tree trunks" and as well under "Small brown birds of the rainforest."

I found the author's gift for simple, yet explicit, description evident throughout the book. In the case of the Olive-backed Oriole, he makes the observation "white underparts with tear-drop shaped striations" - a simple enough comment, yet

most apt in distinguishing these markings from the striations of the female Figbird.

Within this first area there is a "Difficult Groups" section which ably deals with seventeen groups in all. I was particularly impressed with the entry on "Thrushes: Bassian and Russet-tailed", which features clear illustrations of the respective birds' spread tails. As the author says, "these are the most reliable features to separate these two thrushes." Egrets and Cuckoos are two other groups represented in a most helpful fashion. And finally, in this first section, a heading which I found amusing and curious is "Teeters", but as soon as the relevant pages are referred to, all becomes clear. The reviewer will leave readers to discover more about this for themselves.

The second area, subtitled "Status and Range,Habits, "Where To See It" is where the observer, after making the likely identification, is referred for further information. Located in green colour-coded pages this proves to be the full annotated and up-to-date bird list of the Queensland Wet Tropics and Great Barrier Reef. I defy any committed birdwatcher to read the third area, "Best Bird-Watching Areas", denoted again by colour-coded pages, without fantasising about a future trip to the Wet Tropics. Clear full-page maps and easy-to-follow directions to find the best locations can be found here. Detailed information in each entry includes a brief geographical description, notable species, available facilities and specific directions for access.

Another feature in the remaining section of the book is a full geographical index, a welcome addition not always included in this genre. There is also a page devoted to Services, which lists Birdwatching Organizations, Guiding Services, Bird Call Tapes and Wildlife Videos. The information contained in any one of the main areas is reason enough to buy the book. It is invaluable for anyone planning to travel to Queensland's Wet Tropics or the Great Barrier Reef. It also has a much wider application as an identification tool, particularly within difficult groups, many of which have ranges that extend far beyond the geographical areas detailed.

This publication is also a valuable educational tool and will contribute much to people's awareness of the avifauna and diversity of habitats in Queensland's north-east. In the foreward, Dr Christoph Imboden, Director-General of BirdLife International, voices his concern for sustainable development in the fragile World Heritage areas of the Wet Tropics and the Great Barrier Reef. One hopes that through this accessible text, the conservation recommendations expressed by Dr Imboden are furthered.

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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.

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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.

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