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THE SUBURBAN BIRD COMMUNITY OF TOWNSVILLE REVISITED: CHANGES OVER 16 YEARS

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The suburban avifauna of Townsville, north Queensland had been studied during the wet and dry seasons of 1980–81. In 1996–97, the sites and methods used in the earlier study were repeated with the aim of assessing changes in the bird community of this tropical city. No significant differences in species richness or the numbers of individuals were found to have occurred in the 16 years between the two studies. There were, however, significant increases in the numbers of individuals detected for eight species (including Peaceful Dove *Geopelia striata* and Common Myna *Acridotheres tristis*) and significant decreases in numbers of two introduced species (House Sparrow *Passer domesticus* and Nutmeg Mannikin *Lonchura punctulata*).

INTRODUCTION

Interest in the ecological processes and characteristics of urban environments has increased dramatically during the past two decades (Adams 1994). Originally ignored, trivialized or shunned by ecologists, these human-dominated areas are increasingly seen as of considerable importance as wildlife habitats as well as places where humans interact with nature (Erz 1966; Adams 1994; Uhl 1998).

Studies of the birds that have been able to successfully utilize urban habits were among the first undertaken in an attempt to understand the mechanisms and influences at work in these anthropogenic environments. In Australia, urban bird studies began around two decades ago (Jones 1981, 1983; Green 1984) and other studies were soon completed in numerous sites around the country (e.g. Mason 1985; Catterall *et al.* 1989; Munyenyembe *et al.* 1989; Lenz 1990).

One of the first Australian investigations of an urban bird community was undertaken almost two decades ago (1980–81) in the suburbs of Townsville, north Queensland (Jones 1983). Although a few recent population studies have been conducted on single species in urban areas (e.g. Frith *et al.* 1996; Noske 1998), Jones (1983) remains the only published community study undertaken of the suburban avifauna of a tropical location from Australia.

Although urban wildlife studies are increasing in frequency, most are being undertaken in new or recently developed sites where the impacts of fragmentation and rates of establishment of species can be assessed (see Sewell and Catterall 1998). This is welcome but because of the many inherent biophysical and climatic differences between any two locations, comparisons between sites are inevitably limited in scope. In particular, as there have been no longitudinal studies of any single location in Australia, it is difficult to discuss how the structure of urban bird communities may be changing over time. One approach to overcoming this problem is via the selection of sites differing in the period of time since initial construction. Thus, the studies by Jones (1981, 1983) attempted to assess the changes in bird communities for sites differing in age between 1 year and 58 years. Nonetheless, this approach suffers from temporal pseudo-replication (Martin and Bateson 1993); many features other than time may account for any differences found (see Catterall *et al.* 1996; Sewell and Catterall 1998).

To overcome this serious limitation, long-term studies of single locations are necessary. The present study was undertaken to provide a direct temporal comparison between the suburban bird community of Townsville, now and in the past, by repeating the observational methods and visiting the same sites as used by Jones (1983) 16 years previously. In this study we compare the numbers of species and individuals between the two studies for wet and dry seasons, and determine which species, if any, had increased or decreased significantly during the period between the two studies.

METHODS

As far a possible, the methods and sites used in the previous study (Jones 1983) were repeated here. The main difference in technique was the use of 11 different observers (see Acknowledgments) rather than the single observer of the earlier study. While this may have possible implications for the quality of the data obtained, Catterall *et al.* (1996) has shown that the reliability of observers in bird surveys varies significantly between individuals but is less so for experienced observers. All of the observers used in the present study were experienced field bird watchers and all were familiar with the species encountered.

Thirteen sites were surveyed, 12 along suburban streets and one in uncleared woodland within the city boundary. The sites were:

Site	Suburb	Street
1.	Annandale	Berrigan St.
2.	Douglas	Verhoeven Dr.
3.	Annandale	Yolanda Dr.
4.	Wulguru	Jenner St.
5.	Vincent	Blaxland Cr.
6.	Mundingburra	Coorong St.
7.	Aikenvale	Elizabeth St.
8.	Wulguru	Munroe St.
9.	Pimlico	Park St.
10.	West End	Townsville St.
11.	South Townsville	Davidson St.
12.	South Townsville	Hubert St.
13.	James Cook University (woodland site)	

Sites were typically about 200 metres long and 35 metres wide and contained an average of 20 houses. Originally (see Jones 1983) sites were selected to span a range of ages since initial development. By the time of the present study, these sites ranged from 18 to about 70 years of age. As the addition of new species to sites was shown to stabilize after about 13 years of age (Jones 1983), all of the sites could be safely regarded as simply representative of suburban locations throughout the city and we did not consider age as a variable.

Sites were visited by the same observer on three days between dawn and 0830 hours during the dry season (July) of 1996 and the wet season (January) of 1997. Birds were censused during a slow walk along the nature strip with the observer concentrating on one side of the street. Opposite sides of the street were sampled sequentially for about 10 minutes per side. All birds detected between the centre of the street and the house front (effectively this allowed the front yard and the nature strip to be sampled) were identified to species and the number of individuals recorded. Birds outside this strip or seen flying above the tree-tops were ignored. Surveys were not conducted during rain. Data was obtained from all sites during both seasons except sites 11 and 12 which were sampled during the dry season only.

The mean numbers of species and individuals were compared within seasons for sites and years by analysis of variance and paired t-tests. Between-year comparisons of specific sites were conducted separately for seasons using Student's t-tests.

RESULTS

A total of 57 species was detected in the suburban sites in both seasons during the present study (see Appendix 1). Ten of these were species not detected during the 1980–81 study (Table 1). Conversely five species seen in 1980–81 were not recorded during the present study (Table 1). Most of the species listed in Table 1 did not occur in large numbers or in more than one or a few sites, the main exception being the Sulphur-crested Cockatoo *Cacatua galerita* which was found in 5–6 sites during both seasons and made up 3.6 per cent of all birds detected during the wet season.

Several species exhibited statistically significant differences in mean number of individuals detected between the 1980–81 and 1996 studies (see Appendix 1); these species are listed in Table 2. Eight species showed significant increases in number detected while two declined significantly.

TABLE 1

Species detected only during 1980–81 or 1996–97.

1980–81
Masked Lapwing *Vanellus miles*
Yellow-throated Miner *Manorina flavigula*
Rufous Whistler *Pachycephala rufiventris*
Grey Fantail *Rhipidura fuliginosa*
Pied Butcherbird *Cracticus nigrogularis*
1996–97
Rock Dove (Feral Pigeon) *Columba livia*
Collared Dove *Streptopelia decaocto*
Little Corella *Cacatua sanguinea*
Sulphur-crested Cockatoo *Cacatua galerita*
Scaly-breasted Lorikeet *Trichoglossus chlorolepidotus*
Shining Bronze-cuckoo *Chrysococcyx lucidus*
White-throated Needletail *Hirundapus caudactus*
Rufous-throated Honeyeater *Conopophila rufogularis*
Chestnut-breasted Mannikin *Lonchura castaneothorax*
Fairy Martin *Hirundo ariel*

TABLE 2

Species showing significant changes in means numbers detected between 1980–81 and 1996–97 (wet or dry season indicated). (See Appendix 1 for statistical details.)

(a) Species that increased	
Peaceful Dove *Geopelia stricta*	(wet)
Rainbow Lorikeet *Trichoglossus haematodus*	(dry)
White-gaped Honeyeater *Lichenostomus unicolor*	(dry)
Yellow Honeyeater *Lichenostomus flavus*	(wet and dry)
Brown Honeyeater *Lichmera indistincta*	(wet and dry)
Magpie-Lark *Gallina cynaoleuca*	(wet)
Spangled Drongo *Dicrurus bracteatus*	(wet and dry)
Common Myna *Acridotheres tristis*	(wet and dry)
(b) Species that decreased	
House Sparrow *Passer domesticus*	(wet and dry)
Nutmeg Mannikin *Lonchura punctulata*	(wet and dry)

Huhtala and Jarvinen (1977) defined a dominant species as comprising greater than 5 per cent of the overall population. Using this definition, Townsville's 1996 suburban avifauna included six dominant species (Appendix 1) with four of these (House Sparrow *Passer domesticus,* Peaceful Dove *Geopelia striata,* Common Myna *Acridotheres tristis* and Rainbow Lorikeet *Trichoglossus haematodus*) each comprising greater than 10 per cent of the total. The other two species, Magpie-lark *Grallina cyanoleuca* and Brown Honeyeater *Lichmera indistincta,* made up 6.8 and 5.7 per cent of the total respectively.

Comparison of species richness and numbers of individuals by season

There were no significant differences between the two studies for the overall mean species richness for all sites combined during the dry season (1980–81: 6.97±2.41; 1996–97: 9.13±3.2) or wet season (1980–81: 6.5±2.1; 1996–97: 9.12±3.05). Similarly, combined site by site comparisons (paired t-tests) found no significant differences for seasons.

There were no differences in the numbers of individuals detected during the dry season for overall means (1980–81: 31.4±12.7: 1996–97: 37.8±15.6) or for combined site by site comparisons (paired t-test: $t = 1.31$, $p = 0.21$). Again, there were no differences in the numbers of individuals detected during the two studies for wet season (1980–81: 27.2+13.48: 1996–97: 33.1+14.2).

Analysis of variance comparisons using sites as treatments were all non-significant for both species richness and numbers of individuals detected. However, when direct comparisons were made between individual sites significant differences between the two studies were found for certain sites in the means of numbers of individuals detected (Fig. 1) and species richness (Fig. 2). This was especially evident for the species richness data where eight (dry season) and nine (wet season) of the 13 sites surveyed were found to have significantly different numbers of species. The most consistent patterns evident were that sites 1, 2, 3 and 5 supported more individuals and more species in 1996–97 than during the earlier study.

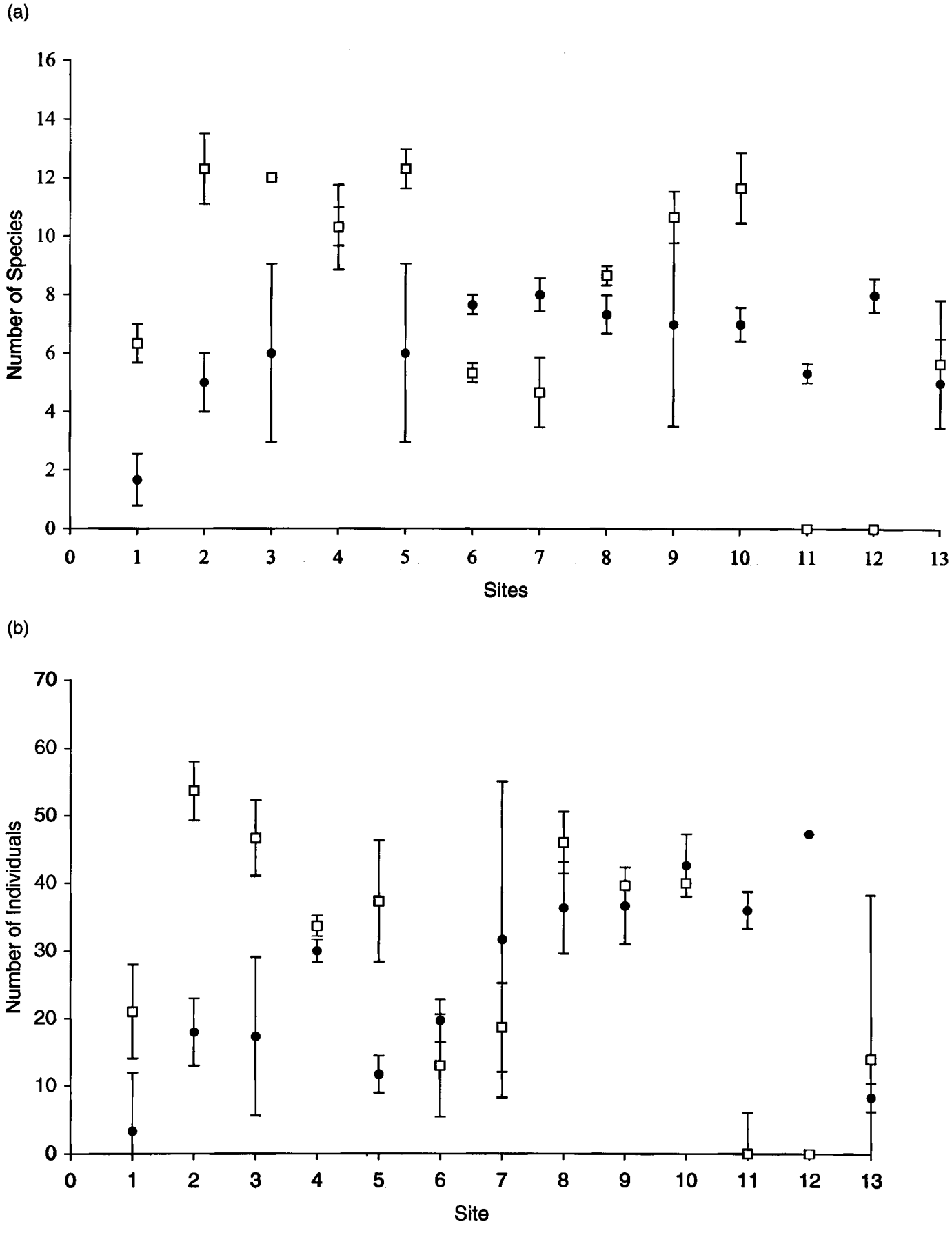

Figure 1. *Mean species richness (a) and number of individuals (b) of suburban birds detected during the dry season (●: 1980–81; □:1996–97).*

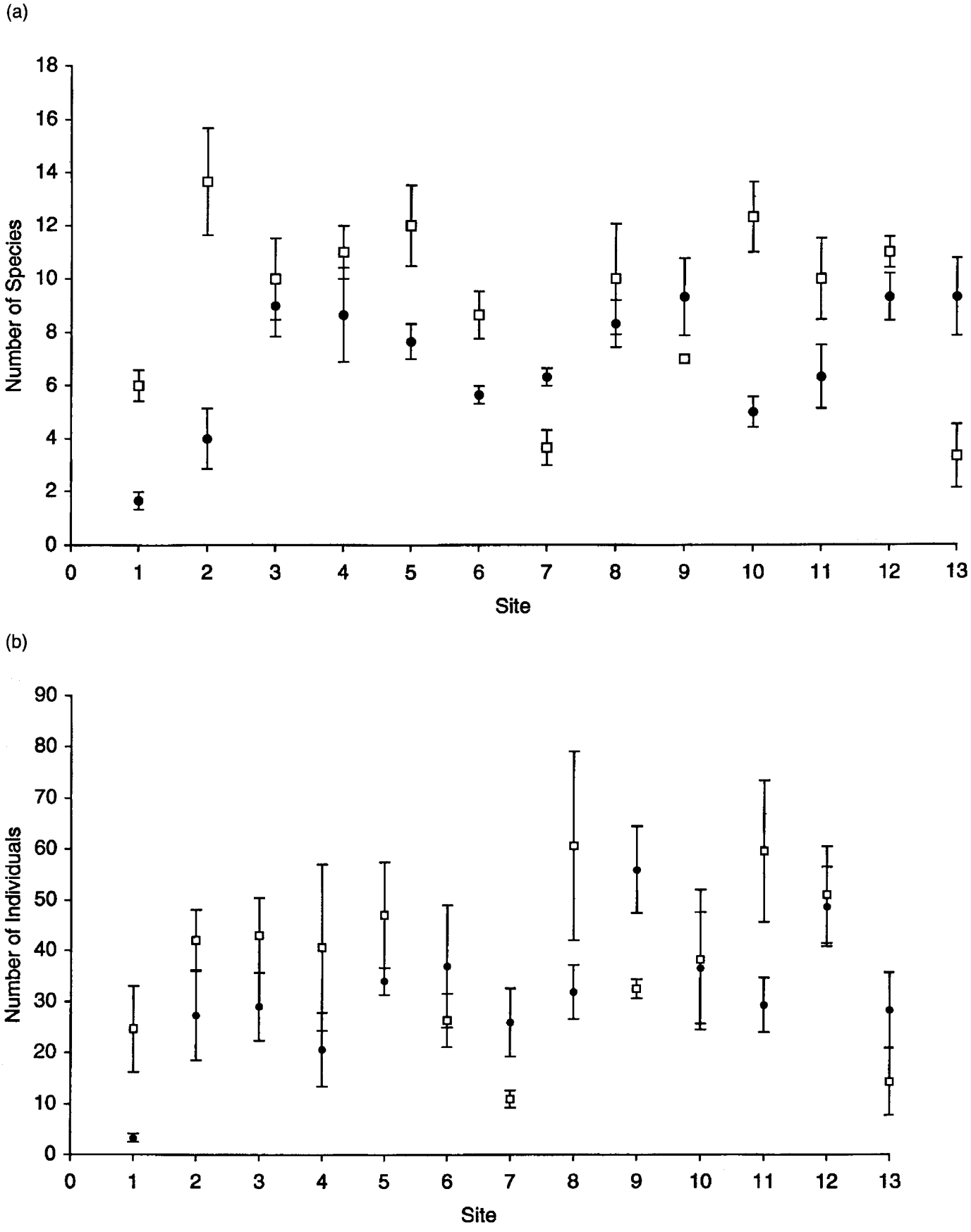

Figure 2. *Mean species richness (a) and number of individuals (b) of suburban birds detected during the wet season (●: 1980–81; □:1996–97).*

DISCUSSION

Changes in abundances of individual species

This study found that, in the 16 years since the previous study, a number of changes had occurred in the avifauna of the suburban environments of Townsville. However, these changes were limited to species composition; there were no consistent differences in species richness or in the number of individuals detected between the two studies (see below).

The two most important of these changes were, first, the disappearance or addition of species, and second, significant increases or decreases in the abundances of other species. For the first of these changes, five species were not detected while ten were added during the present study. The species not detected during the present study were nonetheless widespread throughout suburban Townsville (J. Wieneke, unpubl. data) and appear not to have suffered any discernible decline. Nonetheless, this result does suggest that conditions in the sites surveyed may have altered sufficiently to discourage them remaining within the sites. Two of these species, Grey Fantail *Rhipidura fuliginosa* and Rufous Whistler *Pachycephala rufiventris*, have been found to be less tolerant of suburban development and more characteristic of bushland (Sewell and Catterall 1998) while the others are typically found in more open sites. Masked Lapwings *Vanellus miles* are often seen in parks and recreation areas throughout the city; the only sightings made during the earlier study were of birds in the youngest (one year) suburban site which has virtually no trees (D. Jones, unpubl. data). Yellow-throated Miners *Manorina flavigula* are primarily found in open woodland outside the city though a small group was seen in a recently developed site in the earlier study (Jones 1983). Finally, the Pied Butcherbird *Cracticus nigrogularis*, detected only in the woodland outside the city in 1980–81, was not seen in the present study. This species, although abundant on nearby Magnetic Island, has never been common in the Townsville suburbs and may be declining there (J. Wieneke, unpubl. data).

Most of the species missed or added during the study were not particularly abundant in any site, and their presence (or absence) would have been easily overlooked. The principal exception to this pattern was the Sulphur-crested Cockatoo *Cacatua galerita*, which has become a conspicuous addition to the suburban bird community of Townsville. Certain of the Cacatuidae appear to be well suited to exploiting suburban resources; it is also worth noting that the permanent presence of large numbers of cockatoos in suburban areas has resulted in significant conflicts with human residents (Temby 1992).

The Townsville area experienced a severe drought during 1992–96 and, as has been noted previously (e.g. Lavery 1965), parrots and cockatoos are among the birds that move into urban areas in search of food resources when conditions in the inland become difficult (Bayly 1999). If conditions in the suburban environment are favourable some individuals may remain as residents. This may have been the origin of the present population of Sulphur-crested Cockatoos. Similarly, significant numbers of Red-tailed Black-Cockatoos *Calyptorhynchus banskii*, a species regarded as rare in the 1960s (Lavery and Hopkins 1963), arrived in Townsville around this time and remain locally common. Little Corellas *Cacatua sanguinea,* though not detected in either study, are also resident at all times of the year.

The single report of a Collared Dove *Streptopelia decaoto* is presumably an aviary escapee.

Of the species exhibiting significant changes in abundance between the studies, eight increased while only two decreased in number (see Table 2). The species with the most dramatic increases were the Brown Honeyeater and the Common Myna: both more than tripled their 1980–81 densities. Although one of the smaller honeyeater species, the Brown Honeyeater is an aggressive and agile bird, well suited to exploiting the many nectar-producing garden plants (including Grevilleas, *Callistemon* and others) available (see below). Indeed, Table 2a shows that of the species to increase in abundance, four were nectarivores (a lorikeet and three honeyeaters). An increase in nectarivore numbers has often been noted in other studies (e.g. Green 1984; Noske 1998).

The Common Myna has increased massively in abundance in Townsville since 1980–81 and is now among the most common species in the city. This relatively rapid increase in abundance has been observed in several populations within the species' range in Australia (Blakers *et al.* 1984). Such an increase is by no means a universal characteristic of this species. Elsewhere, apparently established populations have declined for unknown reasons (see Jones 1986).

More than 20 years prior to the 1980–81 study, Lavery and Hopkins (1963) reported Mynas to be 'very common' and 'found throughout the urban areas'. That this species was abundant in 1980–81, suggests that a significant increase in density may have been occurred during the interval between the earlier and present studies. This is of some concern as Mynas have been shown to successfully outcompete local hole-nesting species, and being interspecifically aggressive, high densities of this species may reduce local bird species diversity (Pell and Tidemann 1997). In addition, the species' huge roosts may cause conflicts with people living nearby (Kang *et al.* 1990). Unfortunately, the lack of research on other potential impact of this species precludes our being able to predict future problems.

Although still the most abundant species within the suburban avifauna of Townsville, the density of House Sparrows has fallen remarkably since the previous study. In 1980–81, the House Sparrow dominated all other species, comprising 36.4 per cent of all birds seen. In 1996–97, this proportion had fallen to 16.6 per cent, a figure not statistically different to that of the Peaceful Dove (15.8%). The House Sparrow remains one of the most successful and widely distributed birds species in the world (Summers-Smith 1963) and numerous surveys of urban bird communities — most from countries to which the species has been introduced — have consistently found it to be among the most abundant species detected (e.g. Geis 1976; Vale and Vale 1976; Huhtalo and Jarvinen

1977; Bland 1979; Jones 1981). Nonetheless, in England, the source of introduced populations now dispersed throughout the globe, the species is declining (Gibbons *et al.* 1993). Somewhat surprisingly, House Sparrows in suburban Brisbane are disappearing from certain suburbs, a phenomenon apparently correlated with the arrival of Noisy Miners (Woodall 1996). While Noisy Miners are not present in Townsville (and its cogener the Yellow-throated Miner is common only in woodland sites out of the city), it is possible that the decline detected may be associated with increases in other species such as the Myna.

The changes in the avifauna are further reflected in the changes to the list of dominant species found in Townsville. In 1980–81, there were four dominants: House Sparrow; Peaceful Dove; Nutmeg Mannikin *Lonchura punctulata;* and Rainbow Lorikeet. In 1996–97, this list numbered six: House Sparrow; Peaceful Dove; Common Myna; Rainbow Lorikeet; Magpie-lark; and Brown Honeyeater. The disappearance of the Nutmeg Mannikin from the more recent list is of interest. This was the only species other than the House Sparrow to undergo a significant decrease in numbers between the studies. Jones (1983) speculated that competition was likely between these two introduced granivorous species, a process that had begun presumably with the arrival of the House Sparrow around 1964. Prior to this event, Immelmann (1960) had suggested that the Mannikin filled the suburban niche occupied by the House Sparrow elsewhere. However, local birdwatchers did note that the Mannikin appeared to decline during the 1992–96 drought, probably due to a lack of Guinea Grass *Panicum maximum* which died off at the time.

Changes to overall avifauna

While there have been numerous important changes in the abundance of some individual species, there was very little change evident in terms of overall numbers of species and individuals between the two studies. The only apparent general change was found to be the larger numbers of individuals detected in four sites: 1, 2, 3 and 5 (see Figs 1 and 2). During the 1980–81 study, these sites were among the most recently developed sites selected and were between 1 and 11 years old at the time. As would be expected, during the earlier study these sites had little or very young garden vegetation and most were dominated by House Sparrows and overall numbers of all species was relatively low (Jones 1983). It was in these sites that the greatest differences in numbers were found between the studies; Common Mynas and Peaceful Doves were especially abundant in 1996–97.

Comments for further studies on urban birds

Finally, because we wish to promote further studies of suburban avifauna, some comment on the suitability of the techniques used here needs to be made. As acknowledged earlier, the original study upon which the present study was based had attempted to detect possible temporal changes in suburban bird communities by using sites of different ages as a surrogate for actual changes over time. It is now evident that the approach used in Jones (1983) was seriously pseudoreplicated (see Hurlbert 1984). That is, only a single site was used for each age category, rather than a number of replicates for each age. This may have reduced the applicability of the results to other studies because any effect may have been due simply to the conditions of the single site itself, rather than to the age of the site. Nonetheless, similar results have been obtained using the same approach (e.g. S. J. Kennedy, unpubl. data) as well as when fully replicated (Munyenyembe *et al.* 1989) which does suggest the existence of a robust natural process.

An important outcome of this study is that significant and scientifically valuable studies can be undertaken in urban areas using a group of suitably experienced observers. Having reviewed many studies in this field during the writing of this paper, we suggest that studies that aim to provide reliable bird community data (i.e. that will allow statistical comparisons with other locations) need to take account of the following features when choosing sites: (1) variability of data is best reduced by using a larger number of samples rather than revisiting the same sites; (2) distance to bushland needs to be controlled in order to reduce edge effects; and (3) samples should be distributed across all of the main 'habitat' types represented in the study area (see Catterall *et al.* 1989; Munyenyembe *et al.* 1989 and Noske 1998 for further details).

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APPENDIX 1

Comparison of mean numbers of individuals for all species detected during wet season and dry season for 1980–81 and 1996–97 for all suburban sites in Townsville. (* = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$).

Species	Wet 1980	*P*	1997	Dry 1980	*P*	1997
Australian White Ibis *Threskiornis molucca*			0.13±0.11	0.10±0.01		0.13±0.02
Straw-necked Ibis *Threskionis spinicollis*	0.02±0.23		0.30±0.06	0.36±0.12		0.51±0.11
Black-shouldered Kite *Elanus axillaris*				0.23±0.01		
Black Kite *Milvus migrans*	0.22±0.05			0.10±0.21		0.02±0.25
Brahminy Kite *Haliastur indus*						0.03
Australian Hobby *Falco longipennis*	0.02		0.03±0.01			
Masked Lapwing *Vanellus miles*	0.02±0.01		0.03			
Rock Dove *Columba livia*			0.13±0.31			0.05±0.06
Collared Dove *Streptopelia decaocto*			0.01			
Peaceful Dove *Geopelia stricta*	3.00±0.67	*	5.03±0.47	5.75±1.59		6.70±1.78
Sulphur-crested Cockatoo *Cacatua galerita*	6.33±6.91					
Little Corella *Cacatua sanguinea*			0.53			
Rainbow Lorikeet *Trichoglossus haematodus*	5.50±0.97		5.68±1.87	1.35±0.61	*	3.54±1.06
Scaly-breasted Lorikeet *Trichoglossus chlorolepidotus*			0.13			0.05
Pale-headed Rosella *Platycercus adscitus*	0.05		0.13±0.05	0.05		
Brush Cuckoo *Cacomantus variolosus*			0.03	0.03		
Shining Bronze-cuckoo *Chrysococcyx lucidus*			0.13±0.07			
Common Koel *Eudynamys scolopacea*			0.16±0.08			
White-throated Needletail *Hirundapus caudacutus*			0.27			
Blue-winged Kookaburra *Dacelo leachii*	0.05		0.03			
Sacred Kingfisher *Todiramphus sanctus*	0.07±0.08		0.03	0.05±0.25		

Appendix 1 — *continued*

Species	Wet 1980	*P*	1997	Dry 1980	*P*	1997
Rainbow Bee-eater *Merops ornatus*	0.14±0.07		0.60±0.26			0.73±0.33
Striated Pardalote *Pardalotus striatus*			0.03	0.05±0.25		0.05±0.25
Helmeted Friarbird *Philemon buceroides*	0.07±0.05			0.36±0.06		0.35±0.07
Noisy Friarbird *Philemon corniculatus*	0.05±0.03					0.03
Little Friarbird *Philemon citreogularis*	0.14±0.08		0.23±0.12	0.13±0.23		0.11±0.09
Blue-faced Honeyeater *Entomyzon cyanotis*	0.22±0.10		0.10±0.08	0.37±0.03		1.40±0.98
Yellow-throated Miner *Manorina flavigula*				0.07±0.01		
White-gaped Honeyeater *Lichenostomus unicolor*			1.23±0.03	0.18±0.02	**	1.08±0.06
Yellow Honeyeater *Lichenostomus flavus*	1.00±0.23	**	2.06±0.28	0.21±0.10	**	0.94±0.24
White-throated Honeyeater *Melithreptus albogularis*	0.17±0.05		0.27±0.09	0.31±0.15		0.11±0.22
Brown Honeyeater *Lichmera indistincta*	0.76±0.21	***	2.76±0.48	0.13±0.07	***	2.56±0.33
Brown-backed Honeyeater *Ramsayornis modestus*	0.14±0.27		0.07±0.14			
Rufous-throated Honeyeater *Conopophila rufogularis*			0.10			0.07
Rufous Whistler *Pachycephala rufiventris*				0.05±0.05		
Leaden Flycatcher *Myiagra rubecula*				0.03		0.07±0.14
Magpie-lark *Grallina cyanoleuca*	1.76±0.33	*	3.16±0.39	1.64±0.29		2.35±0.31
Grey Fantail *Rhipidura fuliginosa*				0.10±0.05		
Willie Wagtail *Rhipidura leucophrys*				0.20±0.01		0.15±0.07
Spangled Drongo *Dicrurus bracteatus*				0.03	**	0.43±0.12
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	0.14±0.08		0.17±0.09	0.54±0.18		0.16±0.38
White-bellied Cuckoo-shrike *Coracina papuensis*			0.10±0.10	0.05±0.01		
Olive-backed Oriole *Oriolus sagittatus*	0.05±0.30		0.03			
Figbird *Sphecotheres viridis*	0.88±1.05			1.23±2.85		1.35±1.01
White-breasted Woodswallow *Artamus leucorynchus*			0.57±0.10	0.18±0.36		0.03
Pied Butcherbird *Cracticus nigrogularis*				0.03		
Australian Magpie *Gymnorhina tibicen*				0.05		0.03
Great Bowerbird *Chlamydera nuchalis*	0.14±0.09		0.07±0.14	0.25±0.05		0.24±0.06
House Sparrow *Passer domesticus*	13.08±1.63	*	7.56±1.28	10.05±1.74	*	6.08±0.93
Zebra Finch *Taeniopygia guttata*	2.43±1.15		5.71±1.68	1.56±0.59		1.11±0.71
Nutmeg Mannikin *Lonchura punctulata*	3.80±1.60	*	1.60±0.40	1.56±0.59	*	1.02±0.44
Chestnut-breasted Mannikin *Lonchura castaneothorax*			0.50			
Yellow-bellied Sunbird *Nectarinia jugularis*	0.55±0.15		0.23±0.08	0.37±0.09		0.21±0.12
Mistletoebird *Dicaeum hirundinaceum*	0.14±0.06		0.20±0.09			0.40±0.20
Welcome Swallow *Hirundo neoxena*	0.14±0.07		0.07±0.04	0.18±0.09		0.03
Fairy Martin *Hirundo ariel*			0.07			
Common Myna *Acridotheres tristis*	1.72±0.37	**	3.16±0.39	1.57±0.38	***	5.76±1.02