

Group size and composition in the Grey-crowned Babbler *Pomatostomus temporalis* in an urban environment

Kathryn Teare Ada Lambert¹, David Geering² and Hugh Ford¹

¹Zoology and Research Centre in Behavioural and Physiological Ecology,
School of Environmental and Rural Science, University of New England, Armidale, NSW 2351, Australia.

²Office of Environment and Heritage, P.O. Box 2111, Dubbo NSW 2830, Australia.

Corresponding author. Email: klamber4@une.edu.au

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The Grey-crowned Babbler *Pomatostomus temporalis*, a cooperatively breeding woodland bird, is declining in the southern parts of its range where its social dynamics and reproduction have been negatively affected by fragmentation and degradation of suitable habitat. We studied 12 groups of Grey-crowned Babblers in and around Dubbo, New South Wales, eight in altered habitat and four in the surrounding natural habitat of Ironbark/Cypress woodland. Individuals were captured and colour-banded and weighed. Feather samples were collected for DNA analysis to determine the sex of individuals. There were no significant differences between groups in natural and altered habitat in sex ratio, group size, or mean weight. Mean group size was 6.7 birds, with a mean of 3.3 young birds from the previous two breeding seasons, figures comparable with or better than those in groups from more natural habitats in Queensland and New South Wales. Mean weights were similar to those of birds in the Pilliga Nature Reserve 230 kilometres north of Dubbo, but heavier than those in Queensland. Generally, the population of Grey-crowned Babblers inhabiting areas in and around Dubbo seems to be healthy, although this may change as the city grows.

INTRODUCTION

Habitat fragmentation, degradation and loss are well-known drivers of species extinction. In association with modified interactions with other species, changes in behaviour and biology may cause populations to decline (Reed 1999; Haila 2002). Large tracts of open forests and woodlands in temperate southern Australia have been cleared for agriculture. As much as 90 per cent of the native vegetation has been lost in many districts (Hobbs and Yates 2000). Some woodland birds have suffered contraction of their geographical ranges (Priddel and Wheeler 2003; Ford *et al.* 2009), extinction from districts and regions (e.g. Saunders 1989; Bennett and Watson 2011) and population declines (Gardner 2004; Olsen *et al.* 2005). Many species are now listed as threatened in one or more states.

Species with complex avian breeding or social systems could be more negatively affected by disruptions to biological processes than those with simpler ones (Fischer and Lindenmayer 2007). Habitat fragmentation is believed to disrupt social interaction among groups, reducing group size, possibly leading to inbreeding and resulting in reduced breeding success (Garnett and Crowley 2000; Walters *et al.* 2004). Bird populations in fragmented habitat may have an imbalanced sex ratio, with an excess of males. This is because females, typically the dispersing sex, leave isolated populations at a greater rate than new females arrive (Dale 2001). This leaves many males unpaired and, in the case of cooperative breeders, may lead to groups containing only males (e.g. Walters *et al.* 1999). Individuals living in degraded environments may also show physiological stress, which may be indicated by low body weights (Cucco *et al.* 2002).

The Grey-crowned Babbler *Pomatostomus temporalis* occurs in woodland across northern and eastern Australia, and in New Guinea (Higgins and Peter 2002). *P. t. temporalis* inhabits eastern Australia, with *P. t. rubeculus* in northern, north-western and central Australia. In many parts of south-eastern Australia, Grey-crowned Babblers have declined, due to habitat loss and fragmentation (Olsen 2008). The species is extinct in southern South Australia (Higgins and Peter 2002), endangered in Victoria (Davidson and Robinson 1992) and vulnerable in New South Wales (NSW OEH 2012).

Numerous studies have been conducted on the Grey-crowned Babbler's life history, cooperative behaviour and social structure (Counsilman 1979; King 1980; Brown *et al.* 1982a, b; Brown *et al.* 1983; Dow and King 1984; Blackmore 2006; Blackmore and Heinsohn 2007, 2008; Eguchi *et al.* 2007). The species lives in groups, whose members defend a territory year-round and roost together (King 1980; Dow and King 1984). It breeds cooperatively and most helpers are offspring of the breeding pair from previous broods, genetically evidenced by Blackmore and Heinsohn (2008). Both sexes may become helpers (Brown *et al.* 1983) and can be admitted into the group from other groups (King 1980), but only male helpers improve the reproductive success of the groups (Blackmore and Heinsohn 2007). Groups of two or three have been found to produce few fledglings (Brown *et al.* 1982a; Eguchi *et al.* 2007) and in small fragments, groups eventually disappear (Lockwood and Robinson 1997).

Habitat quality is also important for the Grey-crowned Babbler, which requires specific habitat characteristics (Simondson 2001). Groups are less likely to be found on burnt

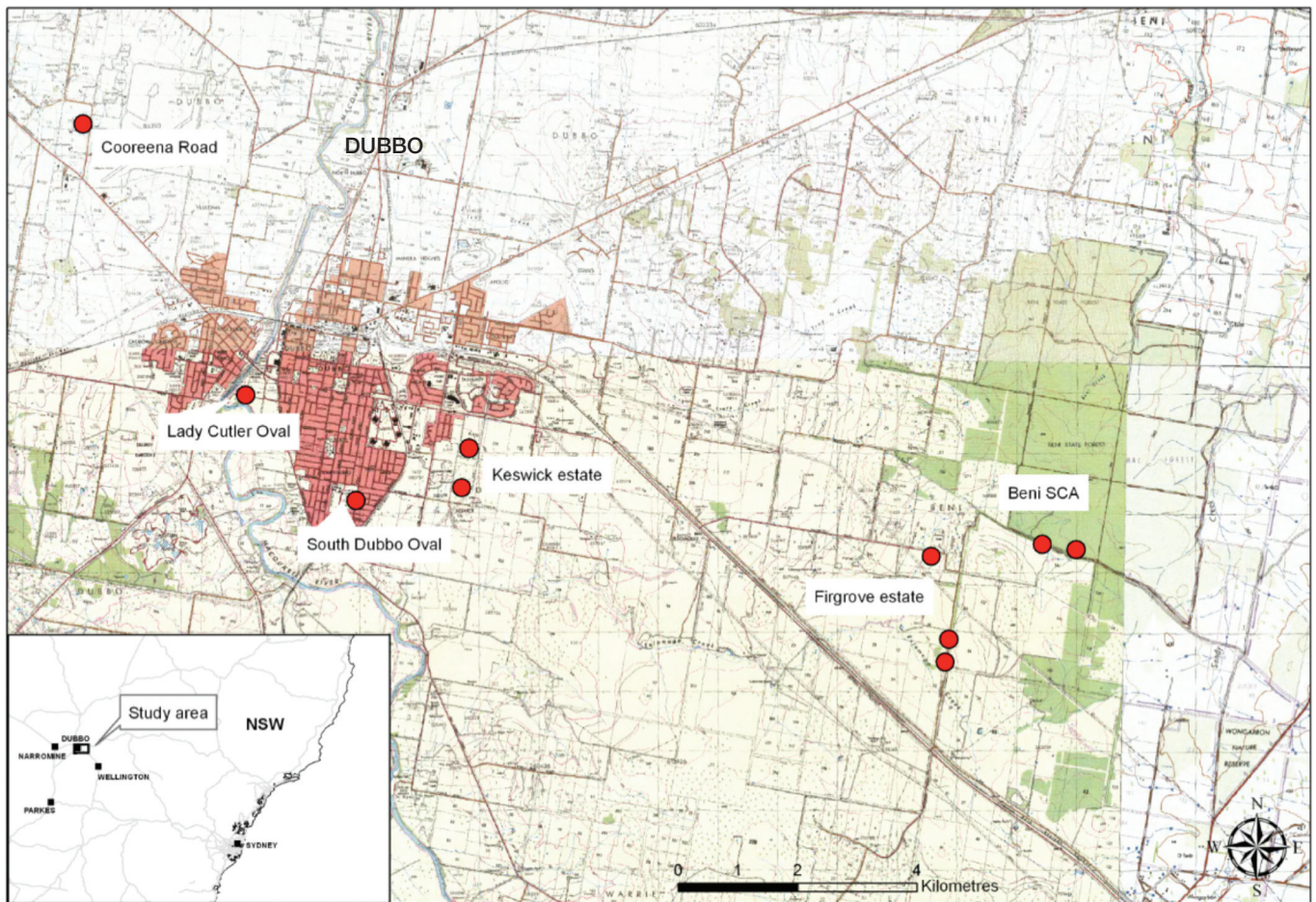


Figure 1. Map of study area. Study groups are indicated in red.

than on unburnt roadsides (Adam and Robinson 1996), and in sites with limited leaf litter and grass, and few large trees and clumps of small trees and shrubs (Robinson 1994). Grey-crowned Babblers in fragmented habitats may also suffer from food shortages in a similar way to the Eastern Yellow Robin, *Eopsaltria australis*, (Zanette *et al.* 2000; and as suggested by Blackmore 2006). They may also have to travel farther to find food (Recher *et al.* 1987). Thus habitat fragmentation and degradation may lead to reduced group sizes and poor reproductive success in babblers. This is supported by numbers of Grey-crowned Babblers increasing in response to revegetation in parts of Victoria (Robinson 2006; Thomas 2009).

Although Grey-crowned Babblers have been studied in fragmented rural landscapes, they have received little attention in urban environments. Urban areas often provide considerable habitat for some bird species, whereas other species do not cope well there (Grim *et al.* 2008; Fuller *et al.* 2009). Grey-crowned Babblers have been sighted on golf courses, in parks and recreational areas (Schulz 1991; Birds in Backyards 2011). They have also been observed near houses and farms (Templeton 1955; Blackmore 2006), but no detailed studies have been conducted on urban groups. We studied the group size and composition of a population of Grey-crowned Babblers in and around Dubbo, in altered remnants through to continuous habitat. If babblers are coping poorly with the altered environment and the population is declining we predict that, in comparison with populations in

continuous environments, they will show: 1) an imbalanced sex ratio, with an excess of males, 2) small group sizes, 3) few young birds in groups, and 4) low average body weights, or the presence of some very light individuals.

METHODS

This study was conducted in and around the city of Dubbo on the border of the Central Tablelands and Western Plains of New South Wales (32°15'45"S, 148°44'25"E) from May to October 2009. Babbler groups were found in natural open forest in Beni State Conservation Area (SCA) (19 km east of the centre of Dubbo), on private, mostly cleared land outside the city (Firgrove Estate and Cooreena Road), in remnant vegetation near a suburban housing estate and vegetation within that estate (Keswick Estate) and in parks, gardens and sporting grounds in the city (Lady Cutler and South Dubbo Oval) (Figure 1). The major vegetation in Beni SCA, referred to as continuous habitat, is Ironbark/Cypress woodland dominated by *Eucalyptus nubila*, *E. crebra* and *Callitris glaucophylla*, with a dense leaf litter and scattered small herbs, forbs and grasses on sandy infertile soil. The private land outside the city had remnant patches and roadside strips of modified native vegetation. The sites in the city contained small patches of natural or replanted vegetation, parkland, private gardens, roads, houses and other buildings. Both of these areas are referred to as altered habitat. Disturbances included traffic, grazing cattle and sheep, motor-cycle riding and

housing development outside the city and pedestrians, cyclists, mowing, domestic animals, recreational activities such as fishing, swimming and sporting events within the city.

We found 45 groups of Grey-crowned Babblers in the area, of which, due to time constraints, only 12 were studied in detail. Four groups were located in continuous habitat, while eight were found in altered habitat (Figure 1). Two Beni groups were not observed after banding. These were: Beni 3 – located on the eastern side of Beni SCA where Sandy Creek meets the forest; and, Beni 4 – located in the middle of Beni SCA. We chose more groups of Grey-crowned Babblers in altered landscapes because previous studies focused on groups in continuous habitat. Grey-crowned Babblers start breeding in July and fledge the last broods in March in temperate climates of New South Wales (Blackmore and Heinsohn 2007). Our study groups bred between October and February (per. obs), so were observed in the non-breeding season, when they use a larger home range than when breeding (Counsilman 1979; King 1980; Dow and King 1984).

Banding

Of the 12 target groups, we successfully captured 68 out of 80 individuals with seven groups completely banded during May 2009 using mist nets and playback of territorial calls. Each bird was banded using a stainless steel band supplied by the Australian Bird and Bat Banding Scheme, plus a unique combination of coloured plastic bands.

Age determination

The colour of the iris of Grey-crowned Babblers changes with age (King 1980). Fledglings and juveniles up to about one year old have a dark brown iris, 1–2 year old birds have a light brown iris, which becomes yellowish-brown in adults 2–3 years old, whereas birds older than three years have a pale yellow iris. We placed each trapped individual into one of these four categories, but we could not determine the age of 11 birds that we failed to catch. We did not classify any individuals as having dark brown irides. As we observed babblers in the non-breeding season we were unable to determine which were the breeders in each group. Sexual maturity is reached at two years in both sexes (King 1980).

Sex determination

We collected seven breast feathers from each individual using the method by Griffiths *et al.* (1998) and sent them to Genetic Technologies Limited in Fitzroy. Sex was determined using the sex-linked chromo-helicase-DNA-binding (CHD) gene, which was used by Blackmore *et al.* (2006) to sex Grey-crowned Babblers.

Statistical Analyses

All data were analysed with χ^2 tests, t tests or ANOVA utilising the MiniTab program.

RESULTS

Group size and composition

Mean group size of Grey-crowned Babblers in Dubbo was 6.67 (standard error = 0.916, $n = 12$), with a range of two to 12 birds. Other than a pair in Beni SCA and a group of three at the Lady Cutler Oval, all groups had five or more individuals. There was no difference in the size of groups between altered (mean = 7, $n = 8$) and natural (mean = 6, $n = 4$) environments ($t = 0.25$, $p = 0.630$).

The proportion of known male and female Grey-crowned Babblers, based on molecular analysis, did not differ significantly from unity (32 males and 34 females; $\chi^2 = 0.06$, $p > 0.05$). Group size did not affect the ratio of males to females ($F = 0.968$, $p = 0.538$). The proportions of known males and females did not differ between altered (23 males, 28 females) and natural environments (9 males, 6 females; $\chi^2 = 0.99$, $p > 0.05$).

Groups contained from one to four pale yellow-eyed adults (more than 3 years old). Two groups at Beni SCA were recorded as having only one pale yellow-eyed individual, although not all individuals in these groups were captured and aged. The group at Cooreena Road on the outskirts of Dubbo contained two pale yellow-eyed birds, both females, but it did contain one brownish pale yellow-eyed individual that could have reached sexual maturity. We found no dark brown-eyed individuals in any group. We assessed 32 birds as having light brown eyes, a mean of 2.67 per group, with up to seven in a group of 11 in Keswick Estate in Dubbo. Birds with a light brown iris hatched in the previous (2008) breeding season and those with yellowish-brown irides from the 2007 breeding seasons. Birds with yellow irides would have hatched in or before 2006. This suggests that the 2008 breeding season had been productive.

All except one group at Beni SCA had individuals with light brown eyes (1–2 years old). Only nine birds in five groups had yellowish brown eyes, with four of these in a group of 11 in the Keswick Estate. This suggests that fewer young were produced in 2007, although some would have died or dispersed. There was no significant difference between the numbers of birds of each age group between altered and natural environments (Figure 2 – $\chi^2 = 1.55$, $p > 0.05$, $df = 2$). In particular we found that the groups in urban sites were as productive as those in natural ones.

Weights

Based on molecular sexing, males were significantly heavier (mean = 83.30g \pm 0.642 SE) than females (mean = 79.63g \pm 0.998 SE) ($t = 9.65$, $n = 23$ males, 24 females, $p = 0.004$), although there was considerable overlap in weight between the sexes (males ranged from 79g – 92g; females ranged from 68g – 88g). Weight showed no difference across age classes ($F = 0.14$, $p = 0.937$). Also, there was no difference in mean weight between birds of either sex between natural (females = 75.3 \pm 2.75 SE; males = 83.2 \pm 1.3 SE) and altered (females = 80.5 \pm 0.99 SE; males = 83.3 \pm 0.75 SE) environments ($F = 0.80$, $p = 0.375$).

DISCUSSION

Although the sample size is small, overall, we found no evidence of imbalanced sex ratios, smaller groups, or fewer young birds in our groups of Grey-crowned Babblers in altered compared with continuous sites. Furthermore, there was no indication that groups in and around Dubbo were smaller than those in any other studies in a range of habitats (Table 1). Our mean group size was similar to that in groups in southern Queensland (King 1980; Moffatt 1982; Brown *et al.* 1983) and of *P. t. rubecula* in central Queensland (Edwards and Kot 1995), but were larger than groups of *P. t. temporalis* in north Queensland (Edwards and Kot 1995), and of *P. t. rubecula* in Northern Territory (Eguchi *et al.* 2007) (Table 1). Groups in Dubbo were also larger than those in the natural woodlands in the Pilliga Scrub (Blackmore and Heinsohn 2007), and, than those in fragmented landscapes in central Victoria (Robinson 2006; Wilson *et al.* 2009). It is possible that some of our groups were counted before dispersal of young birds and those groups at the start of breeding would have been smaller.

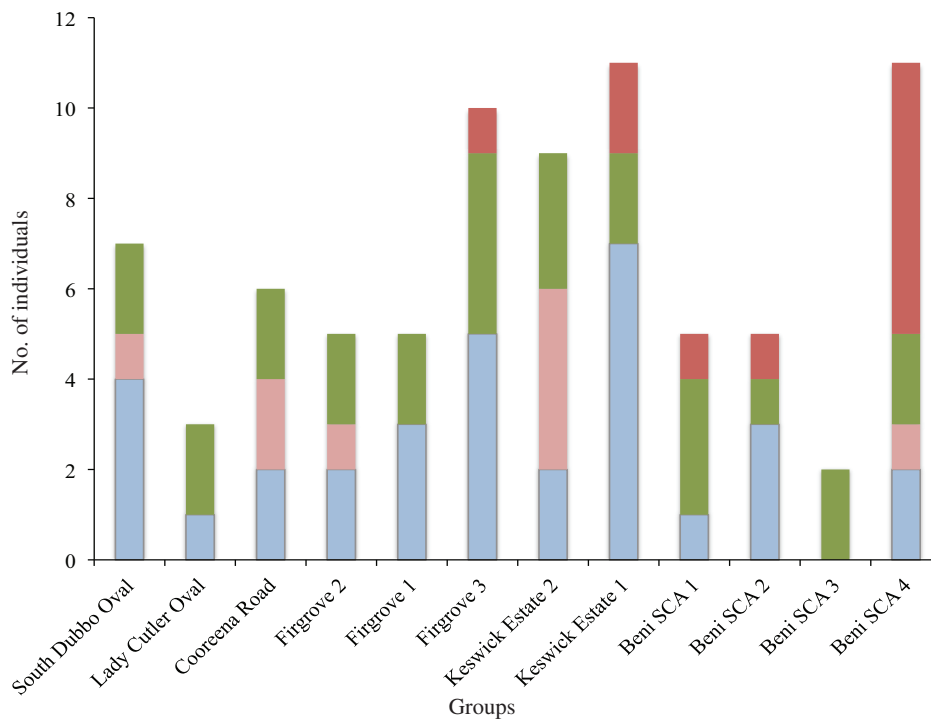


Figure 2. The age composition of each group of Grey-crowned Babblers. Light brown-eyed birds (1-2 years) are blue, yellowish brown-eyed birds (2-3 years) are pink, pale yellow-eyed birds (3 years or older) are green and unknown are red.

Only two of our 12 groups had fewer than four birds in the non-breeding season, the size at which breeding productivity becomes low. Even if some groups were reduced before breeding, the presence of young birds, with light brown or yellowish-brown eyes, in all groups suggests that previously they had been large enough to breed successfully. The area experienced average rainfall for the two years prior to this study but below average rainfall for the two years before that (Bureau of Meteorology 2011). However, we do not know whether groups in altered habitat performed more poorly than those in continuous habitat during the drought. Whereas group size partly reflects previous breeding success, it may also be influenced by groups splitting and by movement of individuals among groups. New group formation may be more common under better conditions, resulting in smaller group sizes in better years (e.g. Counsilman 1977), whereas harsh conditions encourage philopatry (Emlen 1982).

Grey-crowned Babbler group composition around Dubbo was similar to that found elsewhere (Table 2). The other populations, except for that in the Pilliga, had no birds with dark brown eyes, as we found, or very few such birds. Probably the number of birds with dark brown eyes is very dependent on the time of year, as the eyes of young birds become lighter before the next breeding season. The number of birds with light brown or yellowish-brown eyes in our population was similar to or more than that found in other populations.

Although not all individuals in all groups were captured and sexed, the sex ratio of those that were captured was close to unity (32 males, 34 females). Furthermore, all groups had at least one bird of each sex. Hence, there was little indication of an imbalanced sex ratio as often seen in isolated populations

(e.g. Dale 2001), or of groups lacking females, as occurs in other cooperative breeders, e. g. Brown Treecreepers, in highly fragmented landscapes (e. g. Walters *et al.* 1999). It is possible that one sex is easier to capture than the other, though we would expect playback to attract both sexes, or possibly males more than females. It is possible also that one sex may be more likely to disperse before the breeding season, though Blackmore *et al.* (2011) found that both sexes of Grey-crowned Babblers disperse equally. Groups of Grey-crowned Babblers in remnants near the Pilliga Scrub showed a deficiency of females (Blackmore 2006).

In our population, males are heavier than females, as found elsewhere (Counsilman and King 1977; Brown *et al.* 1982b; Blackmore 2006). There was no indication that Babblers in our urban sites were lighter than those in more natural sites. Similarly, Blackmore (2006) found little difference in weights of birds from natural and fragmented habitats in the Pilliga Nature Reserve.

Our results are very similar to those on another cooperative breeder, the White-winged Chough (*Corcorax melanorhamphos*) in Canberra. Beck and Heinsohn (2006) found that urban groups were a similar size, had a similar sex ratio, and produced a similar number of fledglings annually to groups in a nearby nature reserve. Birds in Canberra were a similar weight to those outside the city. There were some differences though, urban groups had fewer adults, started breeding earlier, and had lower nesting success than groups in the natural site.

CONCLUSIONS

The population of Grey-crowned Babblers living in and around Dubbo appears to be healthy. Average group size and numbers of young birds were as high as in any other populations

Table 1

Group sizes of Grey-crowned Babblers from various studies (a: Moffatt 1982; b: this study; c: Edwards and Kot 1995; d: Brown *et al.* 1983; e: King 1980; f: Counsilman 1977; g: Blackmore and Heinsohn 2007; h: Eguchi *et al.* 2007; i: Wilson *et al.* 2009).

Location	Vegetation/Landscape	Sub-species	n	Mean	SE
The Dell QLD ^a	Vegetation remnants	<i>P. t. temporalis</i>	15	7.3	
Dubbo NSW ^b	Vegetation remnants and nature reserve	<i>P. t. temporalis</i>	12	6.67	0.916
Australia and New Guinea ^c	Vegetation remnants	<i>P. t. rubecula</i>	74	6	2.84
Meandarra QLD ^d	Vegetation remnants	<i>P. t. temporalis</i>	46	5.76	
Australia and New Guinea ^c	Vegetation remnants	<i>P. t. temporalis</i>	46	4.5	1.67
Bonningar QLD ^{e,f}	Vegetation remnants	<i>P. t. temporalis</i>	79	4.45	
Pilliga Nature Reserve ^g	Nature reserve and vegetation remnants	<i>P. t. temporalis</i>	47	4.28	0.22
Coomalie Farm NT ^h	Vegetation remnants	<i>P. t. rubecula</i>	19	4.26	8.064
Violet Town, Mogloneby and Molka VIC ⁱ	Vegetation remnants	<i>P. t. temporalis</i>	42	3.6	24.42

Table 2

The age structure of groups of Grey-crowned Babblers from various studies (a: this study; b: King 1980; c: Counsilman 1977; d: Blackmore 2006; e: Eguchi *et al.* 2007).

Location	Group size (mean)	Dark brown	Light brown	Yellowish brown	Pale Yellow	Unknown
Dubbo NSW ^a (n=12)	6.67	0	2.67	0.75	2.25	1
Bonningar QLD ^b (n=7)	6	1.1	0.16	0.95	3.16	0.63
Dyer's Lagoon QLD ^c (n=21)	5.6	1.4	1.4	0	2.4	0.4
Pilliga Nature Reserve NSW ^d (n=47)	4.28	0	1.03	0.61	2.64	0
Coomalie Farm NT ^e (n=19)	4.26	0	0.75	0.98	2.53	0
Fernvale QLD ^b (n=5)	3.8	0.6	1.2	0	2	0

studied and are certainly higher than in the endangered Victorian population (Robinson 2006). There was no evidence of a male-biased sex ratio, and all groups had adult females. Breeding and recruitment in recent years had obviously been successful, despite the recent drought, with all but one group having immature birds or young adults. Finally, individual birds were not especially light, providing no evidence of food shortage or other stresses.

Although the Dubbo Grey-crowned Babbler population appears healthy, this could change. For instance, new housing developments could lead to the loss of vegetation remnants and hence of Babbler groups. We recommend that this population continues to be monitored and recommend studies on the species in other towns or cities. We also suggest that the breeding behaviour and success of the urban groups be compared with a larger sample of groups from continuous native vegetation.

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