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Tolerance of Australian Magpies *Gymnorhina tibicen* Towards Humans: A Comparison Along an Urban Gradient

DANIEL J. ROLLINSON[1,2] and DARRYL N. JONES[1]

[1]Suburban Wildlife Research Group, Australian School of Environmental Studies, Griffith University, Brisbane, Queensland 4111 (D.Jones@griffith.edu.au)
[2]Present address: Global Volunteer Network, P.O. Box 2231, Wellington, New Zealand (dan@volunteer.org.nz)

Summary

The flight-initiation distance, alert distance and several dependent variables were measured to examine the tolerance of Australian Magpies *Gymnorhina tibicen* towards an approaching human. Comparisons were made between Magpie populations located at differing points along the urban gradient. The results show a high degree of intraspecific variation in the responses to humans. Magpies living in urbanised areas, where more frequent human contacts are experienced, responded in a highly habituated manner, whereas Magpies located in rural and semi-natural areas gave a typical fear response when a human approached them. Furthermore, following an approach by a human, the Magpies in rural and semi-natural areas always flew away and remained absent for some time. In contrast, Magpies in urbanised areas either flew away or walked away, often only a short distance. A small percentage of suburban Magpies responded in a highly aggressive manner and attacked the human intruder; such aggressive behaviours were not observed in Magpies located in rural or semi-natural areas.

Introduction

Most urban and suburban bird species utilise particular components of the anthropogenic environment, with such a relationship often being termed synanthropy (Tomialojc 1970; Johnston 2001). The term literally means 'with humans' and has been likened to symbiosis (Johnston 2001). Certain features are commonly associated with synanthropy, such as an ability to utilise the anthropogenic environment for breeding and the utilisation of human-provided food sources. It has been suggested that certain traits or behavioural flexibility/ adaptations are also essential for synanthropic species (Sol *et al.* 2002). One key trait is an ability to tolerate or habituate to the presence of humans within suburban and urban settings (Burger & Gochfeld 1991). Urban-dwelling species unable to tolerate the presence of humans are likely to suffer reduced foraging, resting and breeding opportunities (Giese 1996; Burger & Gochfeld 1998). Furthermore, many urban bird species exploit human-provided food sources, and an ability to tolerate humans often enhances their exploitation of such valuable resources (Cooke 1980) and reduces the cost associated with vigilance behaviour (Fernández-Juricic *et al.* 2001a).

A variable often used to quantify bird tolerance towards humans is the flight-initiation distance (hereafter FID) (Ydenberg & Dill 1986; Rodgers & Smith 1995, 1997; Blumstein *et al.* 2003), also referred to as disturbance distance (Cooke 1980) or flush distance (Holmes *et al.* 1993). It is the distance (from animal to approaching human) when the animal takes flight or otherwise flees. In addition to the FID, the alert distance (hereafter AD) has more recently been highlighted as another variable useful in the measurement of animal tolerance towards humans (Rodgers & Smith 1997; Fernández-Juricic *et al.* 2001b). The AD measurement relates to the distance (between the animal and human) when the animal becomes alert

and aware of the approaching human.

The Australian Magpie *Gymnorhina tibicen*, a medium-sized ground-feeding passerine, is a common species both in rural and suburban areas, and is often associated with the presence of humans (Jones 2002). Anecdotal evidence suggests that the Magpie's ability to tolerate the presence of humans within urbanised areas has facilitated its synanthropy, in particular its successful exploitation of human-provided food sources (Robinson 1956; Jones 2002; Rollinson 2003; Rollinson *et al.* 2003). Nonetheless, most behavioural and ecological studies of the Magpie have been undertaken in rural or natural areas (e.g. Robinson 1956; Carrick 1972; Hughes & Mather 1991), leaving its urban ecology largely unknown (Jones 2002). Remarkably, descriptions of Magpies far from human habitation describe it as a very shy and unapproachable bird (Rowley 1974; Blakers *et al.* 1984), which appears to be at variance with the apparent bold and assertive nature of suburban populations (Jones 2002).

This study aimed to use FID, AD and associated dependent variables to explore the level of tolerance towards humans within Australian Magpie populations, in particular how tolerance may vary along the urban gradient. It is envisaged that the study will provide an insight into the possible intraspecific variation of Magpies' responses to humans and highlight a feature that may lead to synanthropy in the species.

Methods

Responses of Australian Magpies to the approach of human intruders were observed at three points along the urban gradient (suburban, rural farmland and semi-natural) within southern Queensland during 2000. Twenty suburban study sites were established at locations in the southern Brisbane region (27°33′S, 153°03′E). These sites were all typically suburban, containing medium-density house blocks and some parkland (Rollinson 2003). Twenty rural sites were selected from a variety of rural locations in the Mt Cotton region of greater Brisbane (27°37′S, 153°13′E) and were composed of low-density farmland interspersed with remnant native forest. Twenty-three semi-natural sites were located in the St George area, 400 km west of Brisbane (28°05′S, 148°40′E), and were typically in cleared grazing lands or national parks. Much of the vegetation within these areas was unmodified and consisted of shrub and grassland interspersed with extensive areas of open eucalypt *Eucalyptus* spp. and Brigalow *Acacia harpophylla* forest. All Magpies in semi-natural areas were at least 5 km from the nearest homestead. Each study site consisted of an individual Magpie breeding territory containing one male and one female Magpie. From each site we randomly selected a Magpie that was to become the focal bird.

Certain factors have been shown to affect the FID and its associated dependant variables (see Fernández-Juricic *et al.* 2002); therefore, we attempted to eliminate such factors during the current study. In particular, variation in response related to reproductive state was eliminated by sampling all three locations during the same stage of the breeding cycle: the 'large nestling stage', the period just before fledging (typically around October). A possible effect of time of day was reduced by undertaking all observations at approximately the same time (mid morning). Distance to cover has also been shown to affect FID in some species, therefore Magpies were approached only when on open ground and not adjacent to forest or dense vegetation that could provide cover. Finally and most significantly, the distance at which an experimental approach is initiated (starting distance) has also been shown to greatly affect FID (Blumstein 2003). Blumstein (2003) noted that approaches initiated within a trade-off zone (a zone where decisions to either flee or remain are made) would result in variable FIDs that were dependent on the starting distance of the approach. The distance beyond the trade-off zone is suggested as an area where animals cannot detect an approaching predator and therefore is less likely to influence FID. In the current study, preliminary observations (D. Rollinson unpublished data) were undertaken to estimate the distance at which to set the starting distance. We found that 300 m exceeded the greatest distance at which Magpies were observed initiating vigilance behaviour (the trade-off zone) or even becoming aware of the approaching human.

For each focal Magpie used in the study, we initially measured the number of people moving through its territory over a 30-minute period (0.15– 0.7 ha: Rollinson 2003). Following this period,

an observer approached (at an even pace of one step per second) the focal Magpie (while it was foraging on open ground) from a distance of 300 m. We avoided approaching a Magpie that was foraging in close proximity to its mate, as a flight response from a non-focal bird may have initiated a flight response in the focal bird. As the Magpie was being approached we recorded the following:

1. The AD: the distance (from human to bird) when the bird first became alert and aware of the approaching human. This was typically when the Magpie raised its head from the ground.
2. The FID: the distance (from human to bird) when the bird took flight from the approaching human.
3. The resulting behaviour following an approach by a human, recorded as either 'fly away', 'walk away', or 'aggressive response'.
4. The distance that the individual bird moved from its original location following an approach by a human.
5. The number of alarm calls made by the bird being approached during a 5-minute period, starting from when the approach was initiated.
6. The time taken by the individual bird to resume its initial foraging behaviour following an approach by a human.

Distances were measured by recording the landmark feature relevant to the particular observation, and either estimating by eye (short distances <10 m) or measuring the appropriate distance with a tape measure. To avoid inter-observer bias in eye estimation, the same observer (DJR) was used throughout the study.

All analysis of behavioural data was performed in SAS/STAT (SAS Institute Inc. 1987). Exploratory data analysis was performed before final analyses and any data lacking normality were logarithmically transformed [$\log_{10}(x+1)$]. A one-factor ANOVA was carried out on the continuous variables, using the general linear models method of least squares (SAS Institute Inc. 1987). A Tukey test was used to test for differences between the means when an effect was identified as significant in the ANOVA. For the data relating to the resulting behaviour following a disturbance event, a Chi-squared test was used. We report mean and standard error of untransformed data, and P values ≤0.05 were considered significant (Zar 1999).

Results

The level of human activity differed greatly between the three locations (Table 1), highly significantly so between the suburban sites and rural sites, and suburban sites and semi-natural sites (Tukey, $P < 0.05$ in all cases). The difference in human activity between rural and semi-natural areas was less pronounced (Tukey, $P > 0.05$); semi-natural sites recorded no activity during our observations whereas rural sites recorded a limited activity (Table 1).

Table 1: Means, standard errors and results of one-factor Generalised Linear Model Analysis of Variance for the number of humans per 30 minutes and behavioural responses to an approaching human, in suburban, rural and semi-natural Magpie populations. Sample sizes are in parentheses.

Variable	*Suburban (20)*	*Rural (20)*	*Semi-natural (23)*	P *value*
No. people per 30 min.	9.3 ± 1.2	0.5 ± 0.1	0	< 0.001
AD (m)	9.8 ± 1.3	62.6 ± 6.4	83.4 ± 9.3	< 0.001
FID (m)	8.9 ± 1.3	55.7 ± 6.1	61.3 ± 11.0	< 0.001
Distance moved following approach (m)	6.7 ± 1.2	25.1 ± 4.0	51.5 ± 6.3	< 0.001
No. alarm calls per 5 min.	0.8 ± 0.4	3.3 ± 0.8	2.6 ± 0.5	< 0.001
Time to resume original behaviour (sec.)	62.9 ± 9.4	706.8 ± 69.2	1186.3 ± 89.8	< 0.001

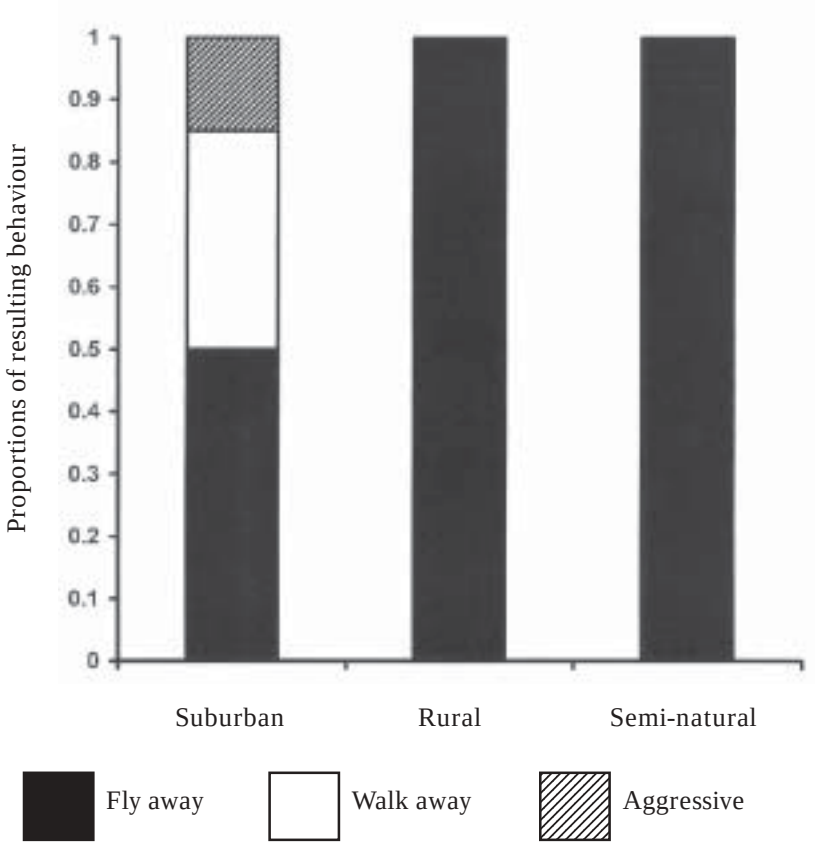

Figure 1. Proportions of the resulting behaviours following the approach of a human, observed in suburban (n = 20), rural (n = 20) and semi-natural (n = 23) Magpie groups.

The response of Magpies to an approaching human also differed between the three locations. Suburban Magpies were the most tolerant of all the three groups. The differences between suburban Magpies and rural Magpies and between suburban Magpies and semi-natural Magpies were significant for all variables measured (Table 1; Tukey $P < 0.05$ in all cases). In the majority of cases, suburban Magpies were very approachable and often they took flight only when the human had approached to a very close distance (mean 8.9 ± 1.3 m, range 2–23 m).

There were significant differences in the resulting behaviours following an approach from a human ($\chi^2_4 = 22.5$, $P < 0.001$). Suburban Magpies primarily walked away or flew away from the approaching human, although a small percentage responded aggressively and attempted to attack the human intruder (Figure 1). In contrast, Magpies located in rural and semi-natural areas always flew away as a result of an approach; there were no instances of these Magpies either walking away or exhibiting an aggressive response (Figure 1).

Following an approach by a human, the distance moved by rural and semi-natural Magpies was considerably greater than that moved by suburban Magpies (Table 1). Suburban Magpies also resumed their prior activity (foraging) in the least amount of time (Tukey, $P < 0.05$). Vocalisations as a result of an approaching human were observed predominantly in rural and semi-natural Magpies; suburban Magpie vocalisations occurred in 30% of events whereas vocalisations occurred in 75% and 78% of disturbance events for rural and semi-natural Magpies respectively. The number of alarm calls per 5 minutes also reflected the difference in vocalisations (Table 1), again showing that suburban Magpies called the least, and was significantly different from the call rates of rural and semi-natural Magpies (Tukey, $P < 0.05$).

Differences in the response to an approaching human were not so pronounced between rural and semi-natural Magpies (Table 1), although some significant differences were still apparent. In particular, the AD of semi-natural Magpies was greater than in rural Magpies (Tukey, $P < 0.05$). Similarly, the distance moved following a disturbance event was greatest in semi-natural Magpies (Tukey, $P < 0.05$), as was the time to resume the prior behaviour (Tukey, $P < 0.05$).

Discussion

The results described here show clearly that Magpies present in areas with frequent exposure to humans had the greatest tolerance of an approaching human. This result strongly suggests that suburban Magpies have habituated to the presence of humans and exhibit a neutral or greatly reduced response. Our findings are similar to previous studies (Cooke 1980; Burger & Gochfeld 1983; Metcalf *et al*. 2000; Ikuta & Blumstein 2003) that noted increased tolerance from avian species as a result of increased human exposure. Suburban Magpies, through their frequent exposure to humans, may have learnt that the potential threat from humans is limited and that the benefits of responding neutrally to human presence allow a greater access to foraging and nesting opportunities, in particular access to human-provided food resources (Rollinson *et al*. 2003).

Nonetheless, a small percentage of suburban Magpies did not respond neutrally to the presence of a human intruder and instead responded aggressively. The occurrence of such behaviours has previously been documented for this species (Jones *et al*. 1980; Cilento & Jones 1999; Jones 2002) and occurs primarily within suburban or high human-contact areas and only during the breeding season (Jones 2002). Considerable effort has been made to explain this behaviour, including the role of hormones (Warne 2001; Rollinson 2003) and the stimuli possibly involved in eliciting these responses (Warne & Jones 2003). The exact reasons for the occurrence of this behaviour are still not fully understood, however, although most evidence suggests it to be a form of nest-defence behaviour (Cilento & Jones 1999; Jones 2002). The results of the current study indicate that habituation or loss of fear within suburban Magpies, presumably resulting from their regular exposure to human intruders, may be a factor causing a small percentage of suburban Magpies to exhibit this potentially costly behaviour. Further work is needed to explore this explanation.

Magpies located in areas of low human contact show a very different response to human intruders, which may be a typical response to something unfamiliar or to a potential threat. Responses commonly involved the use of alarm calls and ultimately fleeing from the approaching human. Interestingly, a difference in some of the variables between rural and semi-natural Magpies was also shown in the

study, despite the level of human exposure being similarly low in both areas. It has been demonstrated that persecution of birds within a specific population results in a greater flight response to humans. For example, Knight (1984) and Knight *et al*. (1987) showed that Common Ravens *Corvus corax* and American Crows *C. brachyrhynchos* exhibited a greater response in areas where they had previously been persecuted. Given that the Magpie is a familiar and popular species throughout Australia (Jones 2002), it is unlikely that the population of Magpies showing the greatest response to an approaching human (semi-natural) was related to persecution. However, shooting of Magpies that attack people is perhaps more likely in rural areas than elsewhere.

The study of avian responses towards humans provides a fairly simply but useful measure of how populations respond to possible threat from a potential predator, and, in the case of this current study, provide information on possible factors that may have facilitated the synanthropy of the species. Furthermore, the use of FID variables is being increasingly used as a conservation tool, providing a measure of how close certain populations of a variety of species can be approached before they are disturbed (e.g. Rodgers & Smith 1995). In the case of the Australian Magpie, FIDs may have possible applications for setback distances aimed at minimising the negative human–wildlife interactions that can occur during the Magpie breeding season (Jones 2002).

This study shows that FID, AD and associated dependent variables can vary according to factors such as level of human exposure. Investigations into responses to human intrusions from the different sexes of Magpies and at different reproductive states are planned. It is hoped that this will further the knowledge of Magpies' behavioural plasticity and urban ecology and also provide further information on how avian populations may vary their tolerance towards humans.

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