

## Relative levels of food aggression displayed by Common Mynas when foraging with other bird species in suburbia

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**Abstract.** Invasive species present economic and ecological challenges worldwide. In many cases we are not aware of the full effect they have on the environment, the extent of any damage, or the factors contributing to their success. In this study we examined the foraging aggression of wild Common Mynas (*Sturnus tristis*) as a potential explanation for their invasive success, and quantified the effect of this behaviour on other birds. Common Mynas did not display significantly more aggression than other species, and displayed significantly less aggression than native Australian Magpies (*Cracticus tibicen*). Furthermore, the presence of Common Mynas at a feeding resource had no greater effect on the abundance of heterospecific individuals than the presence of any other species. Presence of each species was negatively correlated with the presence of other species, that is all species were less likely to approach the feeding station if any other species was present there. Common Mynas also did not displace other birds at feeding sites any more frequently than three of the other four species, and less frequently than two other native species. Overall, the findings suggest that Common Mynas do not display more food-related aggression than other species in suburban habitats, suggesting that competitive aggression over food is not likely to be one of the behavioural traits leading to the success of Common Mynas in suburban habitats.

**Additional keywords:** displacement, foraging behaviour, invasive species, resource competition, *Sturnus*.

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### Introduction

Damage caused by invasive species continues to be one of the major threats to the health and biodiversity of the natural environment worldwide. Research into invasion biology has previously paid too little attention to the role of behavioural traits in increasing the invasive success of a species. Behavioural strategies, however, are likely play a fundamental role in acquiring resources, which are key to the survival of an introduced species. This may be shown prominently in competition over food, a most important and immediately necessary resource.

Common Mynas (*Sturnus tristis*) were introduced to every continent in the world over the past two centuries (Long 1981) and abound worldwide. Since their introduction to Australia during the 19th century they have successfully colonised most of the Eastern seaboard and are rapidly expanding their range inland (Martin 1996). Their success may be partly attributable to behavioural strategies adopted when competing for resources. However, the extent to which competition for resources influences the success of Common Mynas is presently unknown. Despite their large numbers, and the implementation of various control programs to reduce populations, there are very few quantitative data on the effect of Common Mynas on native ecology. Understanding the effects of the presence of Common Mynas and the mechanisms that contribute to their success are the first steps in developing an effective management plan for this species.

Common Mynas are often thought of as aggressive and ‘bullying’ (Phillipps 1994). Anecdotal reports abound with accounts of Common Mynas attacking various bird species including White Terns (*Gygis alba*) (Grant 1982), Mauritius Kestrels (*Falco punctatus*) (Feare and Craig 1999), Tahiti Monarchs (*Pomarea nigra*) (Blanvillain *et al.* 2003), and Samoan Starlings (*Aplonis atrifusca*) (Freifeld 1999). There are even accounts of Common Mynas attacking people, Dogs (*Canis familiaris*), Cats (*Felis catus*) (Booth 1963; Edgar 1975), and a Coati (*Nasua spp.*) (Fitzsimmons 2006). Common Mynas are suspected of driving competing species out of desired nesting hollows and threatening breeding success (e.g. Macdonald 1951; Wright 1962; Councilman 1974; Wright and Wright 1991; Lindenmayer 1993; Pell and Tidemann 1997).

The large anecdotal record of aggressive tendencies in Common Mynas suggests that aggression could contribute to their invasive success. Numerous other studies have attributed the success of an introduced species at least partly to their ability to compete with native species for local resources (e.g. Petren and Case 1996; Poling and Hayslette 2006; for review see Holway and Suarez 1999). Aggressive exclusion has been shown to be an adaptive and effective means of gaining sole access to a resource, such as food, that may not otherwise be available (Brown 1964). However, information on the aggressiveness of Common Mynas in regards to monopolising food resources is lacking. Councilman (1974) records some anecdotal information on the aggression of

Common Mynas around sources of food, but with insufficient observations to draw firm conclusions. Some authors (e.g. Veerman 2002; Crisp and Lill 2006; Harper *et al.* 2005; Olsen *et al.* 2006; Parsons *et al.* 2006) have suggested that the present focus on eradication of Common Mynas is disproportional to the scientific evidence of the threat they present, and indeed thorough quantification of this threat is so far lacking.

Some studies (e.g. Rotenberry 1980) have shown that species that display aggressive competition are not necessarily the most successful ones. Rather, species that use resources opportunistically and discreetly may have greater success. An invasive species that is lacking experience of its competitors may gain by not entering into physical conflict with them. The cost of resource defence is also high (Brown 1964) and, for an invasive species, with little experience of the long-term value of particular resources, initial success may be more likely if as little energy as possible is expended attacking potentially dangerous natives or defending potentially uncertain resources.

A recent observational study suggests that Common Mynas may adopt such a 'laying-low' strategy. Lowe *et al.* (2011) reports that Common Mynas do not show greater interspecific aggression than other species and rarely interfere with their foraging activity. This survey provides an important indication of normal feeding behaviour, but does not address whether Common Mynas show aggression in more extreme feeding circumstances, where the potential pay-off may be higher. It is important that we determine how effective Common Mynas can be at aggressively outcompeting other species for resources as competition for food can result in dramatic population declines (Coblentz 1978). The potential effect on native birds would be heightened by the remarkably broad diet of Common Mynas, forcing even species with specialist diets to compete with them.

In this study, we looked at the feeding behaviour of wild avian populations containing Common Mynas and native species such as Australian Magpies (*Cracticus tibicen*; hereafter simply Magpies), Noisy Miners (*Manorina melanocephala*), Magpie-larks (*Grallina cyanoleuca*), Australian Ravens (*Corvus coronoides*; hereafter simply Ravens), Crested Pigeons (*Ocyphaps lophotes*), and Silver Gulls (*Larus novaehollandiae*); and introduced species including feral Rock Doves (*Columba livia*), Spotted Turtle Doves (*Streptopelia chinensis*), and Common Starlings (*Sturnus vulgaris*; hereafter simply Starlings). If the success of Common Mynas is partly driven by aggressive competition around valuable food resources, we would predict that Common Mynas (when compared with individuals of other species): (1) would initiate more aggressive interactions towards both other Common Mynas and individuals of other species when foraging at concentrated food sources; (2) displace individuals of other species at food sources at a higher rate than these other species do; and (3) their presence would be associated with a disproportionate reduction in the amount of time other species spend foraging at the food source. A 'laying-low' strategy, however, would not result in such differences.

## Methods

### Procedures

Thirty-eight feeding stations were established in public suburban areas in Newcastle, Australia, spanning an area of 10 400 m<sup>2</sup>, with

a minimum distance of 256 m between adjacent feeders. Sites included small parks, pathways, street corners, and suburban backyards. Observations were conducted between 0600 and 1100 hours throughout the Common Myna breeding season (September–March) and non-breeding season (April–August). Individual sites were sampled (as described below) between four and seven times over the course of the study.

The feeding stations contained a mix of commercial seed mix (a blend of Sorghum, Wheat, Barley, French White Millet, Maize, Black Sunflower and shell grit), dog pellets, carbohydrate-rich items (cooked white rice, white bread, Madeira cake), finely chopped fruits (sultanas, raisins, and apricots) and live mealworms (*Tenebrio molitor*). Food was placed on a wooden board 30 × 20 × 1 cm. Wild birds were encouraged to feed from it during two pre-feeding periods. For 7 consecutive days after pre-feeding, birds were video-recorded for 5 min of activity, beginning from the time of the first arrival of a bird of any species at the feeding station. On some days no birds arrived, or birds failed to remain for the full 5 min, and data from these days were not used.

For the purpose of analysis we divided the area surrounding the food board into a foraging zone (a circle of 1-m radius surrounding the feeding board) and an outer zone (a circle of 25-m radius surrounding the foraging zone). This allowed us to note birds present in the area but not accessing the food (outer zone), and those interacting in some way with the food or with other birds accessing the food (foraging zone).

As spatial clumping increases aggression (e.g. Goldberg *et al.* 2001; Robb and Grant 1998), we minimised artificially heightened levels of aggression owing to jostling for physical space at the feeding site by providing food on the board and also scattered within the foraging zone. This allowed birds on the periphery of the foraging zone to access food and reduced the effect of clumping.

### Analysis

#### Aggressive acts

Aggressive acts were defined as behaviours directed at another bird that had the potential to cause harm, and included pecking, chasing and swooping, even when such behaviours were ritualistic only. Video-recordings were played back at 0.5 × normal speed using VLC Media Player 1.0.3 (VideoLAN, Paris, France) and intraspecific and interspecific aggressive acts were continuously scored for all individuals present in the foraging zone. For each aggressive act we noted the identity of both the initiating and recipient species. This resulted in counts for each species of number of initiated interspecific, initiated intraspecific, and recipient aggressive acts. As the numbers of individuals in the foraging zone fluctuated throughout the study period, an abundance score was calculated for each species at each sampled site by counting the number of individuals of that species at each 30-s interval over 5 min and summing these 10 scores. All aggression data from each site was pooled, regardless of the number of within-site trials, and each site was treated as a replicate.

Species that were present in the foraging zone (of any given site) on fewer than 10 occasions were excluded from that site only for the analysis. We calculated a relative aggression score for each species at each site by first calculating how many aggressive acts

we expected each species to be responsible for at each site given the relative abundance of each species and the total number of aggressive acts that occurred at the site. We did this using the formulae:

$$E_{\text{agg}} = (ab_x/AB) \times A$$

and

$$NE_{\text{agg}} = A - E_{\text{agg}}$$

where  $E_{\text{agg}}$  is the number of aggressive events we would expect species  $x$  to initiate;  $NE_{\text{agg}}$  is the number of aggressive acts we would expect species  $x$  not to have initiated;  $ab_x$  is the abundance score of species  $x$ ;  $AB$  is the sum of the abundance scores of all species present at the site and  $A$  is the total number of aggressive events observed at the site.

We then calculated the relative aggression score ( $RA$ ) for each species using the formula

$$RA = [(E_{\text{agg}} - O_{\text{agg}})^2/E_{\text{agg}}] + [(NE_{\text{agg}} - NO_{\text{agg}})^2/NE_{\text{agg}}]$$

where  $O_{\text{agg}}$  is the number of aggressive acts species  $x$  was observed to initiate; and  $NO_{\text{agg}}$  is the number of aggressive acts that species  $x$  was not observed to have initiated. We also defined the  $RA$  score as negative if a species was observed to initiate fewer aggressive acts than was expected and positive if a species was observed to initiate more aggressive acts than was expected. The distribution of these scores was similar to the Chi-square distribution and so they were cube-root transformed before analysis to achieve normality.

Relative aggression scores calculated in this manner are not influenced by either the absolute or relative number of a given species at a given site. This means they will not be higher or lower at one site compared with another simply because there are more individuals or a greater proportion of that species at one of the sites. The sign and magnitude of these scores is also meaningful as a score of zero means that a species is behaving exactly as aggressively as the average aggressiveness of other species with which it shares a site. As different combinations of species (and habitat characteristics) can presumably result in situations that are either more or less conducive to aggressive acts, this score also has the benefit that a low  $RA$  score cannot be attributed to a species simply because it occurs at sites that are relatively unconducive to aggressive acts. This adds validity to between-species comparisons of mean  $RA$  scores (mean calculated for a species from scores from numerous sites).

We calculated three  $RA$  scores for each species, reflecting: (1) interspecific acts of initiated aggression; (2) intraspecific acts of initiated aggression; and (3) events in which the species in question was the recipient of aggression. We conducted a one-way analysis of variance (ANOVA) on the cube-root transformed  $RA$  values with species as the independent variable. In order to minimise the likelihood of Type-II errors and fully explore the data, we used Fisher's Least Significant Difference (LSD) tests for *post hoc* comparisons. Tukey's Honestly Significant Difference (HSD) tests were also applied to ensure that the use of Fisher's LSD tests did not increase the incidence of Type-I errors.

We then correlated the interspecific  $RA$  scores and recipient  $RA$  scores to determine if the species more likely to initiate

aggressive acts were less likely to receive them. The analysis was conducted both with and without the  $RA$  scores of Common Mynas to see if Common Mynas deviated from the trend produced by the other species.

#### Association

During the 5-minute period of observation, recordings of species present in the foraging and outer zones were made at 30-s time-stops. This method, known as instantaneous time-sampling, is described by Martin and Bateson (1986) and has been widely used and shown to give a very close approximation to actual proportion of time spent in a state as measured by continuous sampling (Dunbar 1976; Leger 1977; Tyler 1979).

For each species pair at each site (e.g. Magpies–Ravens, Magpies–Common Mynas) we first calculated how many of the time-stops ( $E$ ) we would expect to see both species present in the foraging zone if the presence of one species was independent of the presence of the other species. We used the following formula:

$$E = (n_x \times n_y)/n_{xy}$$

where  $n_x$  and  $n_y$  are the number of time-stops where species  $x$  and species  $y$  were present in the foraging zone and  $n_{xy}$  is the number of time-stops where both species were present in the outer zone. Inherent in this formula is the assumption that if both species are present in the outer zone, they are equally likely to be present in the foraging zone.

We then calculated an association score ( $AS$ ) for each species using the formula:

$$AS = (O - E)/(O + E)$$

where  $O$  is the number of time-stops at which both species were present in the foraging zone. This created a score that was negative if the species were associating less often than predicted by chance and positive if the species were associating more often than predicted by chance.

We pooled each combination of species pairs by species. Owing to the high proportion of incidences of species pairs never being observed to associate at a given site (resulting in a large proportion of  $AS$  scores being equal to  $-1$ ) the data were not suitable for parametric analysis, so we ran a Kruskal–Wallis test by species. Further Kruskal–Wallis pairwise comparisons between different species were conducted *post hoc*.

#### Displacement

We also recorded displacement events, which involved one or more individual birds leaving the feeding station immediately after the arrival of another bird. This measurement has also been made by Kalinoski (1975) under the name 'avoidance behaviour', and Pryke and Andersson (2003) under the name 'passive supplanting'.

We calculated the number of displacement events we would expect each species to be responsible for based solely on the relative abundance of each species (data were pooled across all sites as the total number of displacement events observed was relatively small,  $n = 36$ ). Expected displacement scores were calculated as:

$$D_{\text{Exp}} = (n/N) \times D$$

where  $n$  is the total number of individuals of the species in question observed across all sites;  $N$  is the total number of individuals of *all* species observed across all sites and  $D$  is the total number of displacement events observed. A Chi-square goodness-of-fit analysis was then used to compare the expected number of displacement events with the observed number for each species.

## Results

### Aggression

A significant effect of species was found for interspecific ( $F_{(7,180)} = 4.382$ ,  $P < 0.001$ ), intraspecific ( $F_{(7,180)} = 3.240$ ,  $P = 0.003$ ), and recipient ( $F_{(1,180)} = 2.292$ ,  $P = 0.029$ ) aggression scores, suggesting that some species displayed significantly more aggression than others. With respect to interspecific aggression, according to Fisher's LSD, Magpies showed significantly greater levels of aggression than most other species (all  $P < 0.025$ ), including Common Mynas ( $P = 0.002$ ), but not including Silver Gulls and Noisy Miners (all  $P > 0.232$ ). When Tukey's HSD tests were applied, Magpies were still more aggressive than Ravens, Crested Pigeons, feral Rock Doves and Common Mynas (all  $P < 0.048$ ), but no longer more aggressive than any other species (all  $P > 0.324$ ). There were no other significant differences between species (by either *post hoc* test) and Common Mynas ranked fourth overall on aggression, behind Magpies, Noisy Miners and Silver Gulls (Fig. 1).

With respect to intraspecific aggression, according to Fisher's LSD, Silver Gulls displayed the highest level of aggression, significantly higher than all other species (all  $P < 0.044$ ), including Common Mynas ( $P = 0.008$ ). When Tukey's HSD tests were applied, Silver Gulls were still more aggressive than Magpies, Crested Pigeons and feral Rock Doves (all  $P < 0.046$ ), but no longer more aggressive than Ravens and Noisy Miners (both  $P > 0.214$ ), or Common Mynas ( $P = 0.141$ ). Common Mynas ranked fourth, behind Silver Gulls, Ravens and Noisy Miners

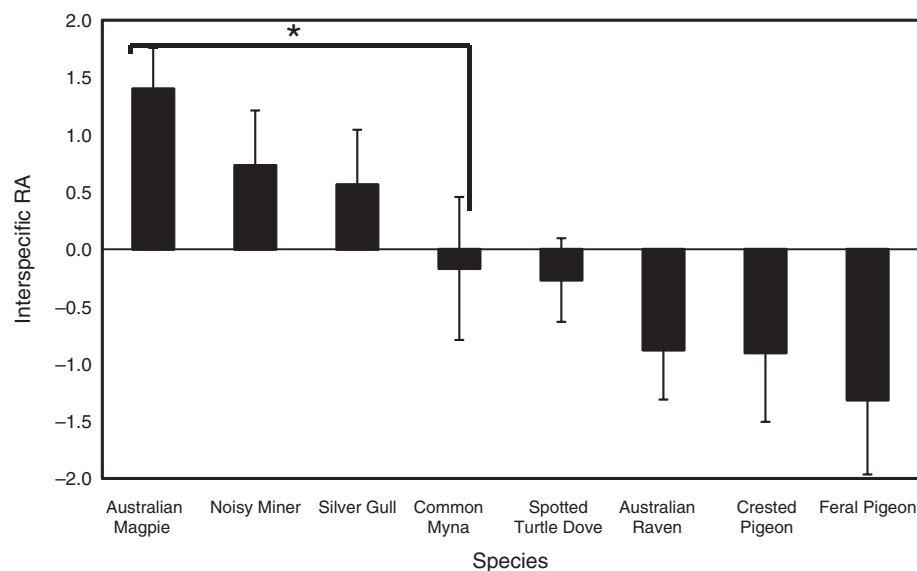
(Fig. 2). Thus, Common Mynas showed intermediate amounts of both intraspecific and interspecific aggression, and did not stand out as the most or least aggressive species in either measurement.

With respect to recipient values, feral Rock Doves and Spotted Turtle Doves received the highest levels of aggression respectively. According to Fisher's LSD test both ranked significantly higher (both  $P < 0.041$ ) than Common Mynas, although this effect was lost when Tukey's HSD test was applied. Common Mynas ranked second to last, indicating that they were not one of the highest recipients of interspecific aggression.

For those data collected in the non-breeding season, there was a trend towards a negative correlation between the mean recipient aggression scores and interspecific aggression scores of each species, with a medium to strong effect size ( $r = -0.6535$ ,  $n = 8$ ,  $P = 0.079$ ). The relationship was in the same direction for the breeding season data but did not reach significance ( $r = -0.3472$ ,  $n = 8$ ,  $P = 0.399$ ). These relationships were similar irrespective of whether Common Mynas were included in the analysis or not (with Common Mynas removed; non-breeding:  $r = -0.709$ ,  $n = 7$ ,  $P = 0.074$ ; breeding:  $r = -0.370$ ,  $n = 7$ ,  $P = 0.414$ ; see Fig. 3).

### Association patterns

All of the association scores calculated for the species pairs were negative, indicating that, for all species pairs, each species was observed in the foraging zone in the presence of the other species less often than predicted by the number of times both species were present in the outer zone if they were approaching the foraging zone independently. Silver Gulls had the highest association scores, Magpie-larks the lowest, and Common Mynas had the third highest association score. This indicates that Common Mynas were more likely than most of the other species to be found in association with heterospecifics. The Kruskal–Wallis tests revealed a significant effect of species ( $P < 0.001$ ), and the *post hoc* pairwise Kruskal–Wallis comparisons showed that Common Mynas had significantly higher *AS* scores than Spotted



**Fig. 1.** Transformed values of interspecific attacks initiated by foraging species. Lines indicate two significantly different values. Only significant differences involving Common Mynas are shown.

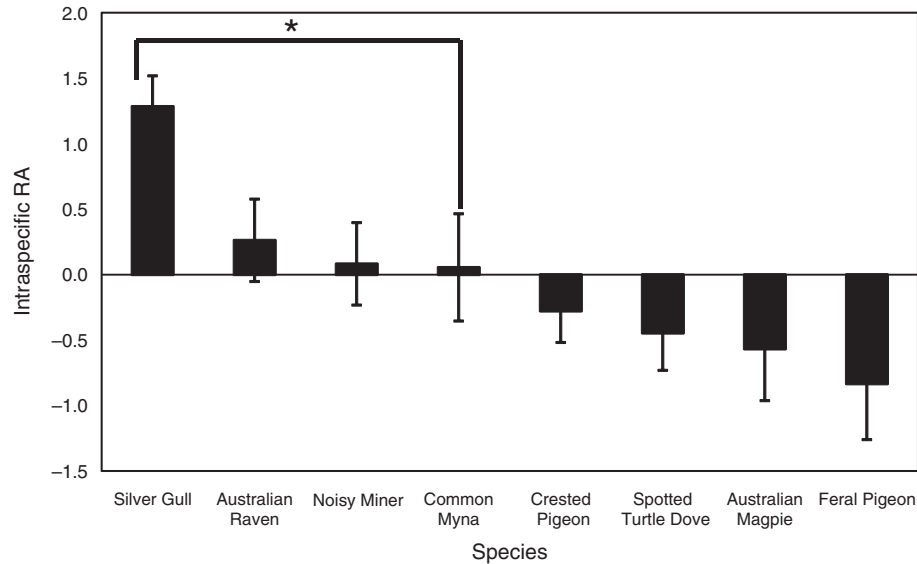


Fig. 2. Transformed values of intraspecific attacks initiated by foraging species. Lines indicate two significantly different values. Only significant differences involving Common Mynas are shown.

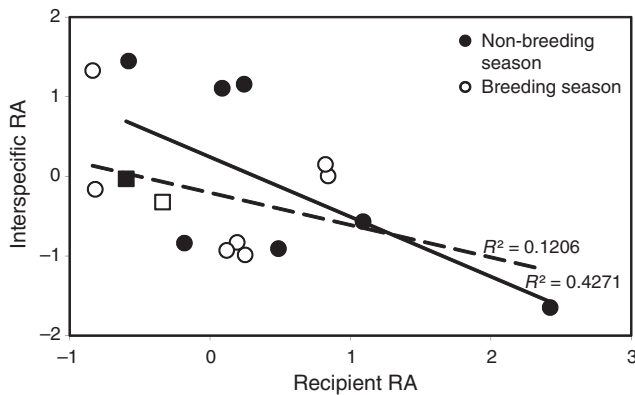


Fig. 3. Negative correlation between interspecific (initiator) and recipient values for breeding and non-breeding seasons. There is a trend indicating that birds receiving fewer attacks are likely to be initiating more attacks, and vice versa. Squares indicate Common Myna breeding season and non-breeding season values.

Turtle Doves, Magpie-Larks and Noisy Miners (all  $P < 0.002$ ), and marginally higher than Common Starlings ( $P = 0.056$ ). They were not significantly less likely to associate with heterospecifics than any other species (all  $P > 0.220$ ; Fig. 4).

*Displacement*

Only five species exhibited displacement behaviour, and this behaviour was uncommon. Of 36 displacement events, Magpies were responsible for 58% (21 of 36), and Common Mynas were responsible for only four. Other species displaced eight times (Ravens), twice (Noisy Miners) and once (Silver Gulls). The Chi-square goodness of fit showed that the observed proportion of displacement events by species was significantly different from that predicted by chance ( $\chi^2_{(4)} = 52.461, P < 0.001$ , Yates Chi-square correction applied owing to some cells having

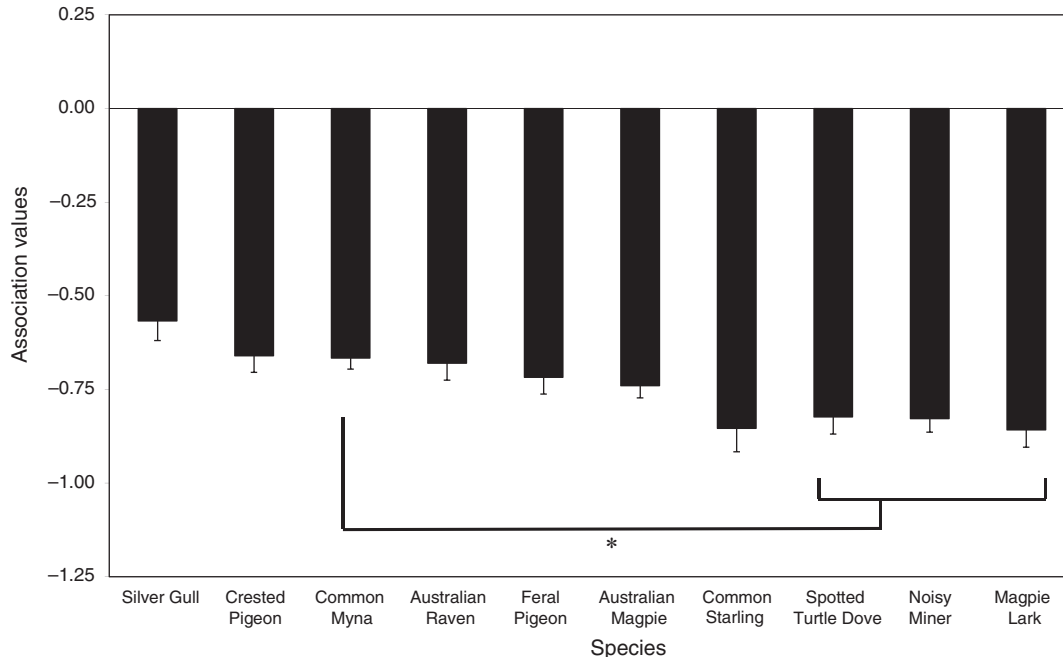
expected value  $< 5$ ). The biggest contributor to this Chi-square value was the Magpie, being responsible for approximately four times as many displacement events as expected.

**Discussion**

This study examined the importance of behavioural aggression around food resources to the invasive success of Common Mynas, and the potential effect of this on native species in suburban habitats. Contrary to anecdotal suggestions and general public opinion, findings suggest that in situations of high food concentration Common Mynas do not display disproportionately high levels of aggression around food and do not monopolise food sources by displacing or preventing other birds from accessing them, when compared with a variety of native and exotic species with which the Common Myna co-exists. It is, therefore, unlikely that aggressively outcompeting other birds for food resources is the key behavioural trait responsible for the invasive success of Common Mynas.

Our findings complement those of Lowe *et al.* (2011), who reported that Common Mynas rarely interfered with other foraging species, and did not initiate aggressive interactions more than other species. It is important to note that their study was conducted in wild foraging situations, with no artificial manipulation of food resources, thus demonstrating that Common Mynas do not show high levels of aggression even during food scarcity, as would be likely in a natural foraging situation. Our findings show that the other extreme foraging situation, that of providing clumped, artificial food resources where species are foraging in very close proximity to one another, also fails to elicit disproportionately high levels of interspecific aggression from Common Mynas.

Our study also found that, across species, there was a trend towards higher frequencies of initiated aggression being associated with lower frequencies of being the recipient of an aggressive act, a relationship that has been demonstrated in other studies



**Fig. 4.** Association values of foraging species. Negative association values indicate species are negatively correlated with the presence of other species, and greater negative values indicate decreased likelihood of association with other species. Lines indicate significant differences. Only significant differences involving Common Mynas are shown.

(e.g. Drickamer *et al.* 1999; D'Eath 2002; Løvendahl *et al.* 2005). Importantly, the behaviour of Common Mynas did not obviously deviate from this trend. Theories of high aggression would predict Common Mynas to fall well above the trendline, indicating a tendency to be involved in disproportionately high levels of interspecific aggression relative to other species. In fact, Common Mynas fell just below the trendline (in both the breeding season and non-breeding season), providing no evidence that they either initiate or elicit aggression more than the other species observed. Common Mynas were only the fifth or fourth most aggressive initiator of the eight species surveyed (depending on whether it was their breeding or non-breeding season), and ranked sixth or eighth of the eight species in likelihood to be the recipient of an aggressive act, in the breeding and non-breeding seasons, respectively. So although Common Mynas may benefit from not being the target of heterospecific aggression, they themselves only exhibit aggression at a rate that is about median when compared with other species with which they occur.

Association scores showed that all species were less likely to be present at the feeder if heterospecific individuals were present. This finding suggests that the birds were actively avoiding heterospecifics, which was somewhat unexpected as it was presumed that birds might use the presence of feeding heterospecifics as cues to the location and profitability of feeding resources. This may still be the case, of course, but with the low association scores being caused by either displacement of one species by another, or passive avoidance of the feeder when heterospecifics are there. Analysis of displacement events revealed that Common Mynas were only responsible for a small proportion of the displacement events, fewer than expected by

chance (based on the relative abundance of the various species). Therefore it is unlikely that Common Mynas are actively monopolising food resources through displacement of other birds. Even to the extent that passive avoidance contributed to the latency scores, there was no evidence that Common Mynas were being avoided more than any other species.

Although scientific findings, including ours, have not revealed Common Mynas to be excessively aggressive, anecdotal reports of aggression persist. Possibly, such attacks have occurred mostly while in defence of nesting sites or young. Excessive nestling defence behaviour is common in many species, both native and introduced (Montgomerie and Weatherhead 1988). Feare and Craig (1999) reported that most Common Myna aggression they witnessed occurred around nesting sites, and only some around food. Other reports of antagonistic behaviour concern aggressive displays from a nesting pair (Booth 1963), and attacks on a Cat during the height of the breeding season in December (Edgar 1975). Airey (1995) reported that Common Mynas attack only during the nesting season, and the rest of the time merely 'scold'.

It may also be that Common Mynas are no more aggressive than other species but that any aggression is more noticeable and obvious to us owing to the strong association Common Mynas have with human activity (e.g. Dean 2000; Peacock *et al.* 2007). Additionally, the status of Common Mynas as an introduced species may lead to a bias in their perceived levels of aggression. Econationalistic ideals held by many Australians decree that introduced, 'outsider' species are unnatural and must necessarily be vicious, greedy and inherently nasty (Trigger *et al.* 2008; Simpson 2010). Native species are seen as gentle and vulnerable, whereas we are quick to expect the worst behaviour of any species seen as foreign to or outside of the natural Australian ecosystem

(Franklin 2006). Thus any aggression from Common Mynas is likely to be noted or reported, whereas other native species can exhibit the same behaviour without drawing the same attention from us.

These findings may inform management efforts aiming to assist natives under threat from the expansion of Common Mynas. They suggest that managerial strategies that involve non-targeted or scattered food-provisioning are not likely to assist native species greatly. In fact, given the broad diet of the Common Myna, such activities may result in a net competitive gain for the Common Myna, especially compared with native species with specialist diets, an obviously undesirable outcome. If Common Mynas are negatively affecting native species or causing their decline as suggested (e.g. Pell and Tidemann 1997; Blanvillain *et al.* 2003), they may be doing so through competition for other resources, such as suitable nesting sites.

## Conclusion

The findings of this study strongly suggest that Common Mynas do not achieve their success in urban habitats through aggressive monopolisation of food sources, actively displacing native birds or disrupting their ability to access food. Attempts to manage the effect of Common Mynas on native bird populations by provisioning extra food intended for native species may not have the desired outcome. Research efforts should now focus on other ecological factors, such as competition for nesting sites, as the potential ground on which Common Mynas gain their competitive edge over natives.

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