Do nest boxes facilitate breeding success in the Hunter Valley? Common Mynas versus native parrots

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Urban environments rich in native wildlife play an essential role in fostering broader public appreciation of natural areas on a global scale. On the New South Wales eastern seaboard, a few native secondary cavity-nesting bird species are successfully colonizing our cities, but their population growth is likely limited by an overall paucity of tree nesting cavities in urban habitats. Here, we sought to determine whether urban nest boxes support breeding by native parrots, or whether competition with non-native secondary cavity-nesters, particularly the invasive Common (Indian) Myna *Acridotheres tristis*, offsets the benefits. We installed and monitored 126 nest boxes in three different locations of the Hunter Valley (Greater Newcastle area, Gloucester and Krambach) across three breeding seasons. Overall, across all locations and all three seasons, native parrots were more common occupants of our nest boxes than mynas. While mynas were the first to breed successfully in the nest boxes, over time native parrots fledged more and more chicks. We discuss the possibility that nest boxes, provided they are maintained across several years, might facilitate colonization of cities by native parrots and their population expansion, while leaving populations of mynas relatively unaffected despite some mynas choosing to nest in boxes. If future research supports this hypothesis, then urban nest boxes could provide a viable management tool for enhancing the presence of native cavity-nesting birds in our cities.

INTRODUCTION

Wildlife in urban areas raises public awareness of biodiversity and the natural world, strengthening citizen support for global environmental protection efforts. Consequently, it is imperative that we design wildlife-friendly cities. In response to rampant urban expansion, a few native Australian secondary cavity-nesting bird species are successfully colonizing our cities. One factor limiting their population growth in these new environments, however, is the overall paucity of tree nesting cavities in urban habitats (Harper *et al.* 2005; Morton 2013) . Australia exhibits the highest number of cavity-nesting birds in the world, but all of them are secondary cavity-nesters (they use existing hollows). No excavating vertebrate species, such as the woodpeckers (primary cavity-nesters), are present in Australia to regularly create new cavities (Gibbons & Lindenmayer 2002). Installing nest boxes is a potential means of supplementing the natural supply of nesting opportunities to facilitate population growth (Griffith *et al.* 2008; Newton 1994). Unfortunately, invasive secondary cavity-nesting bird species, like the Common Myna *Acridotheres tristis*, and mammalian egg and chick predators, like the Brush-tail Possum *Trichosurus vulpecula*, are also common occupants of nest boxes (Grarock *et al.* 2013; Harper *et al.* 2005). There is a risk that the benefits of providing additional nesting resources to native secondary cavity-nesting bird species might end up being off-set by the presence of these competing avian and mammalian cavity users. Even worse, nest boxes might lead to undesirable increases in invasive cavity-nesting birds. Despite these caveats, without careful, quantitative, long-term research, the costs and benefits of urban nest-box programs, and their relative effectiveness, will remain a matter of conjecture. The need to collect quantitative data on the use and effectiveness of urban nest boxes by native and invasive species provided the impetus for the present study. After building an array of 126 nest boxes distributed in several locations across the Hunter Region (New South Wales), we sought to record occupancy and breeding success of native parrots and the introduced Common Myna across three successive breeding seasons.

METHODS

To explore the breeding success of introduced Common Mynas and native secondary cavity-nesting parrots, we installed 126 nest boxes in seven study sites in the Hunter Valley. Seventy-eight boxes were located in the

Newcastle area (New Lambton, Glendale, Waratah, Jesmond and Broadmeadow racecourse) and a further twenty-four were placed in each of Gloucester and Krambach. These boxes were installed within a gradient of urbanisation divided into three sub-environments (egde of the bush, park, and urban) (**Figure 1**). We used vertical nest boxes made of plywood (Nest Boxes Australia, Loganholme 4129 Australia) of internal dimensions 400 (H) x 170 (W) x 170 (D) mm, and equipped with a hole size of 65 mm suitable for native cavity-nesting birds the size of the Psittacidae family and the Common Myna.

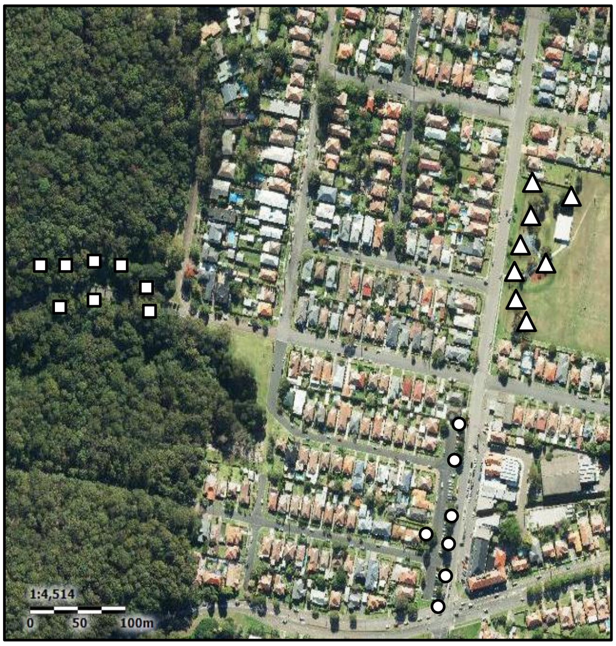

Figure 1. Map of the three different sub-environments of one study site (New Lambton, Newcastle). White dots (urban sub-environment), triangles (park sub-environment) and squares (edge of the bush sub-environment). Each symbol refers to one nest box.

We monitored all nest boxes weekly using a gooseneck camera set up on a long pole for three entire breeding seasons (September 2014 to April 2017). We noted which species was in each box, as well as the number of eggs, nestlings and fledglings. For each nest box, we recorded the number of times a species attempted to breed (at least one egg laid). In cases where no egg in a clutch hatched, or none of the nestlings fledged, we recorded a nest failure. Each time we found a box to be empty the week after it had been recorded as containing nestlings very close to fledgling age, we recorded a successful nest. To estimate the breeding success, the number of fledglings per individual was calculated by dividing the number of fledglings produced by a pair of parents over each entire breeding season by two (i.e. number of chicks surviving /2).

RESULTS

Nest box occupancy

Overall, 23.02% of the 126 nest boxes were occupied by bird species during the first (2014-2015) breeding season. Occupancy increased to 30.16% during the second (2015-2016) breeding season and to 32.54% during the third (2016-2017) breeding season. We found native parrots in approximately 55% of occupied boxes, whereas Common Mynas occurred only in approximately 45% of occupied boxes (**Table 1**). The first breeding season, 11 boxes were occupied by Eastern Rosellas *Platycercus eximius*, 3 by Crimson Rosellas *Platycercus elegans* and 1 by Rainbow Lorikeets *Trichoglossus moluccanus*. The second breading season, 20 boxes were occupied by Eastern Rosellas, 1 by Crimson Rosellas and 2 by Rainbow Lorikeets. The third breeding season, 21 boxes were occupied by Eastern Rosellas, 1 by Crimson Rosellas and 1 by Rainbow Lorikeets. A few boxes were occasionally occupied by Brushtail Possums. Six boxes were regularly occupied by this species but essentially in boxes set on the edge of the bush (3 boxes in Glendale and 3 in Gloucester) where no birds were found nesting in this sub-environment.

Breeding success

Common Mynas fledged on average 1.06 ± 0.15 SE chicks per individual over the three seasons. This rate was twice that of native parrots, which fledged on average 0.59 ± 0.87 SE chicks per individual (**Table 1**, **Figure 2**). Myna breeding success increased from Year 1 to Year 2, but showed a slight decline in Year 3. In contrast, breeding success of native parrots increased consistently across the three years of the study (**Figure 2**).

Causes of failure

Across the three breeding seasons, we recorded 39 nest failures in native parrots for 71 nesting attempts (57%), whereas we recorded only 27 nest failures in Common Mynas for 68 attempts (38%). The percentage of nest failures varied across the breeding seasons. Both native parrots and mynas experienced high levels of nest failures in the first breeding season (75% and 59% respectively). Percentage failure decreased the following year to around 30% in mynas before remaining stable. Native parrot nest failures progressively decreased across the three breeding seasons to reach levels comparable to mynas in the third year of monitoring. Unfortunately, it is impossible to tease apart the causes of failure. For this reason, we split the causes of failures into only two categories for which we could be relatively certain: hatch failure and chick death. Using this categorization, the cause of nest failure differed between mynas and native parrots. Native parrot clutch failure was mostly attributable to hatch failure (~85%), whereas chick death was the most common cause of nest failure in Common Mynas (70%).

Table 1. Nest occupancy and breeding success in Common Mynas and native parrots across three breeding seasons in the Hunter Valley.

Site	Breeding season	Species	% of occupied boxes	Number of eggs	Number of fledglings
Newcastle	1	mynas	20.37	52	11
		parrots	16.66	33	4
	2	mynas	25.92	89	40
		parrots	37.03	115	22
	3	mynas	31.48	108	36
		parrots	31.48	77	26
Gloucester	1	mynas	0	0	0
		parrots	16.66	20	0
	2	mynas	0	0	0
		parrots	8.33	9	0
	3	mynas	0	0	0
		parrots	12.5	17	7
Krambach	1	mynas	12.5	16	4
		parrots	8.33	10	6
	2	mynas	8.33	9	3
		parrots	4.16	6	3
	3	mynas	4.16	5	2
		parrots	12.5	11	5

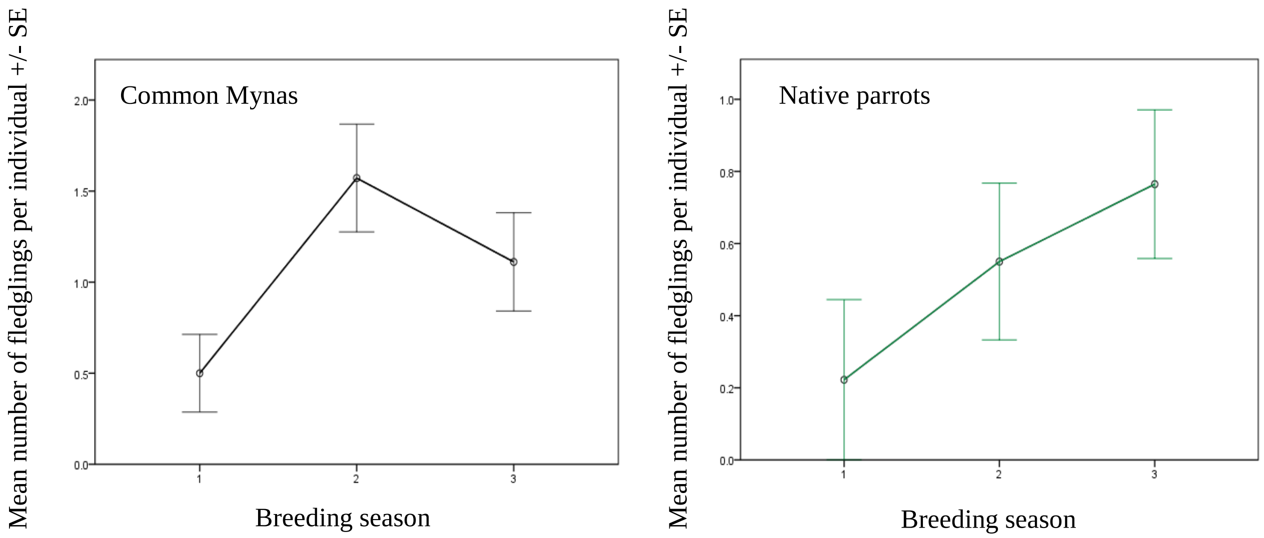

Figure 2. Evolution of breeding success (mean number of fledglings per individual +/-SE) in Common Mynas and native parrots across three successive breeding seasons in the Hunter Valley.

DISCUSSION

We undertook to study nest box occupancy and breeding success of native and invasive secondary cavity-nesting birds in the Hunter Region over the course of three successive breeding seasons. Our aim was to evaluate the effectiveness of urban nest boxes as a wildlife intervention strategy to support colonization of urban areas by native parrots. We found that occupancy increased across years, but native parrots, particularly Eastern Rosellas, were consistently more common occupants of the boxes than Common Mynas. Even though possums occupied a few boxes and many boxes remained empty, these patterns of occupancy by native parrots suggest that supplementing natural nesting cavities has the potential to assist the reproduction of native secondary cavity-nesting parrots even in the presence of the introduced secondary cavity-nesting Common Myna.

Nest box uptake is only the first step, however. Birds also need to be able to breed successfully in them. Although we found that native parrots displayed initially a lower reproductive success than the invasive Common Myna, this disadvantage decreased to almost zero in the third breeding season. Across the three years, the percentage of nest failures in native parrots (mostly Eastern Rosellas) dropped significantly and breeding success almost doubled. At this stage, we do not know why the principal cause of nest failure appears to be hatch failure in native parrots, and chick death in mynas.

At this stage of our research, we can only speculate about whether our boxes provided opportunities to individuals that would not have otherwise reproduced. However, based on our general observations, we suggest that native parrots do not (at this stage of urban colonization) commonly nest on man-made structures, such as the eaves and gutters of houses. In contrast, it is well known that Common Mynas are capable of nesting in a very large range of man-made structures. Hence, we suggest that our nest boxes are likely to have provided opportunities for native parrots that would not have otherwise nested elsewhere, whereas in contrast, Common Myna occupants, given the high nesting flexibility of this species, would have found alternative nesting locations had they not nested in our experimental nest boxes. This idea might be consistent with the heavy hatch failure in native parrots. We speculate that our nest boxes might have been taken up in Year 1 by young native parrot pairs looking for a territory to breed for the first time, and perhaps incapable of competing for natural tree cavities with older established pairs. These inexperienced breeders showed low breeding success initially, but returning each year to the same nest box, gradually gained breeding success and increased their breeding success across the three years of the study. At the present time, this idea remains pure conjecture. More research involving long-term monitoring and individual identification of native parrots, must be undertaken to test this hypothesis. Determining why so many eggs of native parrots do not hatch and whether this phenomenon is limited to the early years of nest box colonization will be particularly important for informing management practices.

CONCLUSION

Providing additional nesting sites (e.g. nest boxes) for native secondary cavity-nesting birds in urban areas could help support their colonization and population expansion in our cities. However, our new study indicates that these artificial nesting opportunities must remain in place for several years for native parrots to breed in them successfully. Our hypothesis that nest boxes provide supplemental nesting opportunities for native parrots that would not otherwise have reproduced, but only alternative nesting opportunities for mynas, which would have otherwise bred elsewhere, will require further investigation. If supported, this scenario will have the important implication that urban nest boxes can enhance population growth in native parrots while leaving Common Myna populations unaffected despite their use of them. Increasing the number of native parrots in urban areas might ultimately provide a competitive barrier to the Common Mynas and place downward pressure on the urban populations of this invasive bird.

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