No short-term change in avian assemblage following removal of Yellow-throated Miner (Manorina flavigula) colonies

Thea O’Loughlin*, Luke S. O’Loughlin and Michael F. Clarke (Department of Ecology, Environment and Evolution, La Trobe University, Bundoora, Vic. 3086, Australia; Email: thea.oloughlin@anu.edu.au;)

*Present address: Fenner School of the Environment and Society, The Australian National University, Canberra, ACT 0200, Australia.

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Summary

The overabundance of Yellow-throated Miner (Manorina flavigula) has been shown to negatively affect the abundance and richness of small birds in areas they occupy, leading to homogenization of the avifauna across the fragmented landscape. In this study, we took advantage of a planned management cull to ask the question, does the removal of Yellow-throated Miner colonies cause an immediate change in avian species richness and abundance? This cull was undertaken around the Bronzewing Flora and Fauna Reserve (north-western Victoria, Australia) in order to protect a resident population of endangered Black-eared Miner (M. melanotis) from hybridization. We conducted avian surveys along roadsides surrounding the reserve at Yellow-throated Miner colonies (n = 6), control sites with no miners (n = 7), and where colonies were removed (n = 3). We found that the cull was followed by only a very modest increase in the species richness and abundance of small birds, with no significant effects on avian assemblage overall. This result contrasts with far more dramatic increases following culls of other species of miner. Sites where miners were removed were not depauperate of other species prior to the cull, which could have been due to a combination of proximity to refuge for small birds in a neighbouring reserve or the low numbers of miners that made up each culled colony. This study highlights that assumed effects of a management action may be highly dependent upon spatial and temporal context.

Introduction

The overabundance of native miners (Manorina spp.) continues to be a major conservation issue in Australia (Maron et al. 2013; Thomson et al. 2015). These highly aggressive birds – including the Noisy Miner (M. melanocephala), Bell Miner (M. melanophrys) and Yellow-throated Miner (M. flavigula) – have increased in both range and abundance following the anthropogenic simplification of the landscape through habitat clearing and fragmentation (Clarke et al. 2007; Kutt et al. 2012; Mac Nally et al. 2014). Miner colonies are associated with decreased avian diversity and altered community assemblage, particularly a loss of small insectivorous birds (Loyan et al. 1983; Grey et al. 1997, 1998; Maron et al. 2013; O’Loughlin et al. 2014; Thomson et al. 2015). Miners aggressively exclude these birds from areas they occupy, which can also lead to outbreaks of psyllid insects and poorer tree health (Loyan et al. 1983; Clarke & Schedvin 1999; O’Loughlin et al. 2014). Mitigating the direct impacts on threatened bird communities and the indirect impacts on habitat quality of these overabundant native species requires active management.

Removal of miner colonies via culling has been suggested as necessary to mitigate their negative impact on avifauna generally (Thomson et al. 2015) and for the protection of threatened species specifically (Baker-Gabb 2001). Local-scale removal studies of Noisy Miner and Bell Miner have demonstrated positive to mixed results. The removal of Noisy Miners from remnant vegetation has resulted in immediate influxes of honeyeaters and other insectivorous birds, increasing species richness and abundance in the landscape (Grey et al. 1997, 1998). Similarly, Bell Miner removal has been followed by immediate colonization by small insectivorous birds and a reduction of abundant psyllids (Clarke & Schedvin 1999). However, these changes did not improve tree health and Bell Miners eventually recolonized the site. These studies show that culling of miners should, at the very least, have an immediate positive influence on avian diversity in the short term.

There are currently no published data of avian community response following the removal of Yellow-throated Miner colonies. This is despite the species being the most widespread miner in Australia (occurring throughout arid and semi-arid wooded areas), having significant impacts on the abundance of small insectivorous birds (Mac Nally et al. 2014; O’Loughlin et al. 2014; Kutt et al. 2015), indirectly impacting tree health (O’Loughlin et al. 2014), and the subject of regular culls to protect the nationally endangered Black-eared Miner (M. melanotis) from hybridization (Baker-Gabb 2001). Given the published data on other Manorina species, it was hypothesized that the removal of Yellow-throated Miner colonies via targeted culls would result in an immediate influx of species that were being aggressively excluded. This study took advantage of a planned management cull to ask the question, does the removal of Yellow-throated Miner colonies cause an immediate change in avian species richness and abundance?

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Methods

Study area and site selection

This study was conducted in 2008 along roadsides surrounding the Bronzewing Flora and Fauna Reserve (Fig. S1), a 12,000 ha remnant patch of mallee vegetation south of Ouyen, north-west Victoria, Australia (−35.246 S, 142.333 E). This area receives on average only 334 mm of rainfall annually, supporting semi-arid vegetation. However, it should be noted that the timing of this study was in the eighth year of a 10-year period of below average rainfall. This large reserve does not represent the majority of remnant vegetation throughout the mallee, which exists in linear strips of road verges and small patches. Sites for this study were dominated by several species of mallee form eucalypts and had sparse shrub understories consisting of saltbush species and an *Eremophila* sp.

The presence or absence of a Yellow-throated Miner colony was determined using Black-eared Miner callback for 90 s through car speakers, at points roughly 500 m apart throughout the survey area (within 3 km of the reserve boundary). Yellow-throated Miner responds aggressively to this call, grouping and then flying or perching near the source of the recording and calling loudly (O’Loughlin et al. 2014). An assessment of a Yellow-throated Miner colony was undertaken following confirmation of presence. A site was defined as a colony if three or more individuals were observed (O’Loughlin et al. 2014). The centre of a colony’s territory was defined in one of two ways. First, if birds were recorded nesting, the location of the nest was regarded as the centre of the colony’s territory. Second, if no breeding activity was detected, the centre was defined as the area of highest observed activity. Nine colony sites and seven control sites where no Yellow-throated Miner individuals occurred were included in this study. Sites were located a minimum of 500 m apart.

In late October 2008, a Parks Victoria staff member used a shotgun to remove 30 Yellow-throated Miners from three of the nine identified colonies. Colonies selected for removal were those closest to the reserve and therefore of highest management concern. This cull was conducted to protect a population of threatened Black-eared Miners within the reserve from hybridization with Yellow-throated Miners.

Field methods

Avian surveys were conducted along a 200 m transect that extended along the middle of the road at each site. The transect spanned 100 m in each direction from the centre of the site. This study focused on birds that utilized vegetation within the corridors, meaning that only the vegetated zone from roadside to paddock fence was surveyed, not the agricultural matrix. The entire vegetated area either side of the road was surveyed at each site. If the surveyed site presented a particularly wide remnant, the width of the surveyed zone ceased at 35 m from the edge of the road, in order to keep sampling effort consistent among those sites with smaller vegetated areas.

All sites were surveyed four times before the cull (early to mid-October) and four times after (early to mid-November). Surveys consisted of ten minutes of observation along the transect, noting species presence, abundance and interspecific aggressive behaviour for those species seen and heard. Transects were walked in a single direction to minimize the risk of counting the same bird twice. Surveys were undertaken from dawn until 1100 h or until conditions became unsuitable; surveys were not undertaken in the rain, if wind moved main branches or if the temperature was over 35°C (see O’Loughlin et al. 2014). Birds were only included in a survey if they perched within the surveyed zone, or interacted with other species. All birds circling overhead and scanning within the transect were included.

Data analysis

Differences in species richness and avian abundance were compared between the three treatments (colony that was culled: ‘removed’, colony that was not culled: ‘colony’, and area where no miners were present: ‘control’) pre- and post-cull. Surveys of each site for each time period were pooled together with species richness determined as the number of species recorded over four surveys and avian abundance calculated as the average number of individuals per survey. These data were also analysed for richness and abundance in relation to bird size. Birds were determined to be ‘small’ (<25 cm length) or ‘large’ (≥25 cm length) in relation to Yellow-throated Miner size (Mac Nally et al. 2014; O’Loughlin et al. 2014; Kutt et al. 2015). Species richness was modelled using generalized linear mixed models with Poisson distributions and avian abundance was modelled using linear mixed models. Variables were modelled as a function of treatment and cull (pre/post) with the replicate and the average number of Yellow-throated Miners present included as random effects. Tests for overdispersion undertaken for species richness models found no additional variation in the data than assumed by the Poisson distribution. *P*-values for avian abundance models were obtained by likelihood ratio tests of the full model compared with the null model (full models with factor of interest removed). All analyses were performed using the lme4 package (Bates et al. 2014) in R version 3.1.2 (R Core Team 2014).

Results

A total of 52 bird species were recorded during this study (Table S1). The number of Yellow-throated Miners at
colony sites each survey ranged from zero to eight (mean = 2.46 ± 0.29 SE). The number of miners recorded at removed sites on a survey precull ranged from zero to four (mean = 1.83 ± 0.60 SE), and sites remained miner-free postcull except for a single survey in which one individual was recorded at one site. Of the 26 species that were recorded at removed sites during the study, 11 were absent prior to the cull and only occurred at those sites after the cull (Table S1).

The Yellow-throated Miner cull had no effect on the species richness (Fig. 1a–c) when considering all birds (Z = 0.34, P = 0.73), only small birds (Z = 1.38, P = 0.17) or only large birds (Z = −0.88, P = 0.38). Species richness was significantly less at colony sites relative to controls for all birds (Z = −3.13, P = 0.002) and small birds (Z = −5.77, P < 0.001), but did not differ for large birds (Z = 1.80, P = 0.07). Although the species richness of small birds at removed sites increased a little following culling, it was still lower than at control sites (Z = −2.00, P = 0.05; Fig. 1b) during the same period.

There were significantly fewer birds at colony sites compared to control sites for all birds (χ² = 6.90, P = 0.03) and small birds (χ² = 10.93, P = 0.004), but not for large birds (χ² = 4.33, P = 0.11 Fig. 1d,e). The Yellow-throated Miner cull had no significant effect on avian abundance (Fig. 1d–f) when considering all birds (χ² = 0.95, P = 0.33) or only large birds (χ² = 1.33, P = 0.25). Although the abundance of small birds at removed sites increased slightly following the cull (χ² = 3.20, P = 0.07; Fig. 1e), the change was not statistically significant relative to control sites.

**Discussion**

Sites occupied by Yellow-throated Miner colonies contained fewer species and a lower abundance of small birds than sites naturally lacking Yellow-throated Miners, consistent with the well-documented negative effect Yellow-throated Miner colonies have on small insectivorous birds (Mac Nally et al. 2014; O’Loughlin et al. 2014; Kutt et al. 2015). However, this situation was not dramatically altered by the culling of Yellow-throated Miner colonies around the edge of a large reserve. Those sites where colonies were removed were found to have similar total species richness and abundance as control sites, including the abundance of small birds. The cull did not result in a significant increase in the species richness of birds relative to increases also observed during the same period at control sites.

These results are in contrast to removal studies of other miner species which have all reported significant immediate increases of small birds which had previously been aggressively excluded (Grey et al. 1997, 1998; Clarke & Schedvin 1999). This difference was likely due to the way our study targeted colonies for their proximity to the reserve, rather than selecting colony sites at random to cull. Total species richness and abundance did not differ between removed or control sites before the cull, suggesting these colonies were not initially having the strong negative effect on the avian assemblage expected or observed in the other colony sites. Unlike other removal studies that were specifically designed to test the effect of miners on other birds, our study took advantage of a cull that aimed to protect a threatened species from hybridization. Our goal was to test whether the
management action had an effect beyond its primary goal. Overall, this cull should be considered successful as it removed all Yellow-throated Miners closest to the reserve, and we did not record any immediate reformation of colonies. Despite this, there was no strong positive effect of the cull on bird species richness or abundance was observed.

Colonies targeted for culling had slightly higher bird abundance and species richness than other colony sites before the cull. The avian assemblage of these ‘removed’ sites prior to culling more closely resembled controls where no miners were present. One reason for this pattern could be proximity to intact vegetation. It has been suggested that habitat extent and structure is a major factor moderating the influence of miners (Clarke & Oldland 2007) and Yellow-throated Miners appear to also be strongly associated with fragmented vegetation (O’Loughlin et al. 2014; Kutt et al. 2015). Small birds in other areas where Yellow-throated Miner dominate are advantaged by greater amounts of remnant vegetation (Mac Nally et al. 2014; Kutt et al. 2015). The reserve may act as a refuge for small birds to quickly retreat to when subjected to interspecific aggression, allowing them to intermittently use the colony sites. Such refuges would be lacking in other colony sites, which were more linear fragments of native vegetation surrounded by open paddocks or cereal crops.

The lack of a cull effect could also be due to the number of individual miners comprising each colony. In the case of the Noisy Miner, a single colony can contain up to several hundred individuals (Maron et al. 2013) and studies consistently identify strong negative relationships between densities of miners and the abundance of small birds (Kutt et al. 2012; Maron et al. 2013). Sites that were culled did, on average, have smaller colony sizes compared to colony sites that were not culled, although this difference was not significant. O’Loughlin et al. (2014) found that the presence of only a single miner was enough to reduce the abundance of small birds by half. It is likely that the small colony size in this study may be interacting with proximity to refuge and/or other habitat properties to allow small birds to persist in the vicinity of the colony.

Alternative explanations for the lack of a strong effect could be the short duration and limited spatial replication of this study. The cull took place in a landscape suffering its eighth year of drought, and the density of small birds may have been so low in the region at the time that there were few birds available to colonize culled sites. During this prolonged period of drought (c. 2001–2009), a significant decline in avian abundance was recorded in many other parts of south-eastern Australia, as a result of low breeding success due to reduced food availability (Mac Nally et al. 2009). Recolonization within this landscape might not be a short-term process, and therefore, our post-cull surveys may have been over too brief a period to detect the actual response. Finally, the relatively low amount of replication (both number of sites and number of surveys) in this study might not have been sufficient to reduce the variability in the data or have the statistical power to demonstrate a more subtle effect. These limitations could all be addressed by conducting a broader-scale removal study, focused solely on testing the response of the avian assemblage, rather than designing a study around a small-scale management action.

Despite seeing little effect of the cull, this study does provide another empirical example of the negative influence of Yellow-throated Miners on avian assemblages generally. This homogenization of the avifauna in marginal habitat occurs wherever miners form aggressive colonies (Maron et al. 2013; Thomson et al. 2015), and minimizing this influence is therefore of significant conservation management concern. Further work is needed to clarify where and when the greatest gains from culling might be achieved, if our goal is to restore avian diversity to fragmented landscapes affected by miners.

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References


Supporting Information

Additional Supporting Information may be found in the online version of this article:

**Figure S1.** Location of sites along roadsides surrounding Bronzewing Flora and Fauna Reserve in northwest Victoria, Australia.

**Table S1.** List of species observed in this study (excluding yellow-throated miner).