doi: 10.1111/emr.12196

SHORT REPORT

Short report

Habitat selection by a despotic passerine, the Bell Miner (*Manorina melanophrys*): When restoring habitat through Lantana (*Lantana camara*) removal is not enough

Kathryn T. A. Lambert[1], Lalit Kumar[2], Nick Reid[2] and Paul G. McDonald[1] ([1]Zoology Department, School of Environmental and Rural Science, University of New England, Armidale, NSW 2351, Australia; Email: kathryn.ta.lambert@gmail.com; [2]Ecosystem Management, School of Environmental and Rural Science, University of New England, Armidale, NSW 2351 Australia.)

Key words: *Bell Miner (Manorina melanophrys), forest structure, habitat restoration, Lantana camara, understorey.*

Summary

The Bell Miner (*Manorina melanophrys*) occurs in logged eucalypt forest in northern NSW with a dense understorey of the invasive Neotropical shrub Lantana (*Lantana camara*) that is used for nesting. The link between Bell Miners and Lantana is important as the birds aggressively exclude all smaller and similar-sized birds from their colonies, reducing avian diversity in forest occupied by the species. We monitored the impact of Lantana removal on Bell Miner persistence in several plots in two logged forest sites, along with untreated control plots at one of the sites. Lantana control was successful over 7 years at both sites, with regeneration of native understorey, midstorey and canopy species compensating for the loss of live Lantana cover in the understorey. Bell Miner individuals vacated the treated plots in one site (Creek's Bend) but persisted in the control and treated plots at the second site (Toonumbar National Park). Bell Miner response was correlated with forest structure: birds vacated forest with a sparse understorey (<5 m) but dense midstorey (5–15 m) and canopy (>15 m) at Creek's Bend, but remained at the site with a dense understorey but sparse midstorey and canopy at Toonumbar. We therefore predict that forest restoration that simultaneously reduces Lantana understorey and increases midstorey density will be most successful in reducing the abundance of the despotic Bell Miner and increasing avian diversity in rehabilitated sites.

Introduction

Singular species can markedly influence the structure of ecological assemblages by decreasing or suppressing diversity. These 'despotic' species can mediate a phase shift, which is an assemblage change that is brought about by the species' behaviour (Donahue *et al.* 2011). The underlying mechanism for such phase shifts, although driven by the actions of the despotic species, is often ultimately due to human-based land-use change. In this way, even native species affected by human activities have become agents of ecological imbalance. For example, habitat fragmentation has resulted in increased invasion of forest remnants by avian nest parasites and predators, and the resulting decline in reproductive success has been associated with the altered structure of forest bird assemblages (Maron 2009).

The despotic Bell Miner (*Manorina melanophrys*) is an aggressive honeyeater that negatively influences avian diversity (Leseberg *et al.* 2014) and is positively associated with Lantana (*Lantana camara*), an invasive Neotropical weed of logged eucalypt forest in eastern Australia. Lantana understorey is a preferred nesting site for the Bell Miner owing to the protection afforded to nests by the dense foliage (Kathryn T. A. Lambert and Paul G. McDonald, unpubl. data, 2015). In this study, we monitored the impact of the removal of Lantana to examine how the miners reacted to habitat restoration in two sites. Our aim was to determine whether the removal of Lantana nesting habitat would result in the relocation of Bell Miner colonies, thereby providing a relatively cost-effective and rapid means for land managers to restore the forest avifauna in sites formerly occupied by miners.

Methods

Toonumbar National Park and adjacent 'Creek's Bend', a private 470-ha property, border Richmond Range National Park in northern NSW and have been extensively treated for Lantana. The vegetation is a mix of dry sclerophyll and wet sclerophyll forest and rainforest (Somerville *et al.* 2011). Both Toonumbar National Park and Creek's Bend were treated for Lantana from 2002. Lantana was treated every 6 months to 1 year using a splatter gun containing glyphosate (see Somerville *et al.* 2011 for detailed

© 2016 Ecological Society of Australia and John Wiley & Sons Australia, Ltd

Figure 1. (a) Untreated lush Lantana understorey; (b) treated dead Lantana with pioneer rainforest species beginning to colonise the understorey in the Toonumbar Valley, NSW.

methodology). Treatments began on roadsides and, over the years, extended into the forest up to 300 m from road edges, as the Lantana declined and died. Lantana had almost been completely removed in treated areas, whereas areas yet to be treated contained lush healthy Lantana (Fig. 1). We sampled six Lantana-treated plots (20 × 20 m) and seven untreated (control) plots in Toonumbar National Park, and five treated plots in Creek's Bend (all wet sclerophyll vegetation) in October 2014, noting the incidence of Bell Miner and identifying vascular plant species and abundance in treated plots. All plots were at least 50 m apart and 20 m away from the roadside. All individuals of vascular plants >0.1 m high occurring within each plot were identified to spe-

 © 2016 Ecological Society of Australia and John Wiley & Sons Australia, Ltd

cies where possible, classed as exotic or native, counted and allocated to understorey (0.1–5.0 m high), midstorey (5.1–15.0 m high) or canopy (>15 m high). To determine whether there was a difference in vegetation health due to Lantana treatment, satellite images of treated and control plots were compared before and after treatment (Appendix S1).

Results and Discussion

Bell Miners persisted in Toonumbar National Park in 2014 in both treated and control plots as noted by observing their presence in each plot visually. In contrast, Bell Miner was absent from Creek's Bend. According to Somerville *et al.* (2011), miners gradually declined in density at Creek's Bend from 2005, when Lantana treatment commenced (1 year after the first satellite image was taken), to 0 birds by August 2011 when Lantana had been removed (and the second satellite image was taken).

We expected treated plots to have a similar NDVI to control plots in 2005 but a lower NDVI than control plots in 2011, due to the death of Lantana in the understorey in the intervening period. Despite the successful treatment of Lantana, no difference in NDVI between treated and control plots was detected before (2004 treatments: $F_{2,11} = 0.320$, $P = 0.584$) or after treatment (2011 treatments: $F_{2,11} = 0.140$, $P = 0.716$), nor between treated plots in 2004 and 2011 ($F_{1,10} = 0.541$, $P = 0.479$). Regeneration of native understorey, midstorey and canopy plants in the intervening period (Fig. 2) evidently masked the death of Lantana in treated plots.

Our results suggest that native plant regeneration after Lantana treatment proceeded more slowly at Toonumbar National Park than at Creek's Bend, despite the apparent higher productivity of the former (judged by tree height, girth and composition). It is likely that the dense shrub layer in the understorey of the Toonumbar plots inhibited native tree regeneration (Gooden *et al.* 2009). Alternatively, the allelopathic inhibition by Lantana of native plant establishment and growth (Duggin & Gentle 1998) was more persistent at Toonumbar than at Creek's Bend.

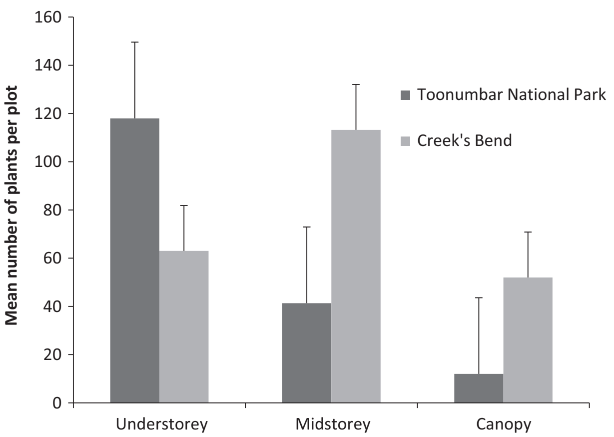

Figure 2. Mean number of plants (±1 SEM) in each vegetation stratum in treated plots in Toonumbar National Park (where Bell Miners remained) and Creek's Bend (where Bell Miners relocated).

Furthermore, the evidence suggests that Bell Miner colony occupancy changes were driven by differences in forest structure once the Lantana understorey was successfully treated. Supporting evidence that the density of native midstorey and canopy trees influences the occurrence of Bell Miner colonies comes from the work of Stone *et al.* (2008), who found that Bell Miner was absent in forest stands containing a midstorey with high stem density and little understorey.

Plants with high foliage density in the understorey and midstorey, such as Lantana, are preferred nesting habitat (Kathryn T. A. Lambert and Paul G. McDonald, unpubl. data, 2015) and affect Bell Miner presence. In the present study, Bell Miners occurred in treatment and control plots at Toonumbar National Park with an understorey containing plant species with high foliage density, such as water vines (*Cisus* spp.) and Native Raspberry (*Rubus parvifolius*) in treatment plots and Lantana in control plots. Stone *et al.* (2008) noted that Bell Miners did not occur in forest stands with an understorey and midstorey of Spotted Gum (*Corymbia maculata*) and Blue-leaved Stringybark (*Eucalyptus agglomerata*) with low foliage density. The preference of Bell Miners for an understorey or midstorey containing species with dense foliage may explain why colonies persist in some forest stands with a dense midstorey but no understorey (Stone *et al.* 2008).

Conclusions

Experimental restoration of native forest at two sites through successful control of Lantana in the understorey over a 10-year period resulted in Bell Miners vacating one site but not the other, evidently due to differences in forest structure post-treatment. With Lantana control, Bell Miners vacated forest at Creek's Bend, presumably leading to an increase in avian species diversity, but remained in the Toonumbar plots. A dense midstorey and canopy layer was associated with the loss of Bell Miners, whereas an open midstorey and canopy and dense understorey of native plants with dense foliage were associated with Bell Miner persistence. While this study was conducted at only one site and so results cannot be generalised, we hypothesise that forest structure may thus be more important than understorey plant composition in predicting occupancy by Bell Miners and, indirectly, the diversity of the avian species assemblage. Assuming that Lantana control continues, we predict that as native forest regeneration proceeds at Toonumbar and stem density increases in the midstorey and canopy layer and the foliage density of the understorey declines, Bell Miners will vacate the treated Toonumbar plots in time.

© 2016 Ecological Society of Australia and John Wiley & Sons Australia, Ltd

Acknowledgements

We would like to thank Kate McGregor for her enthusiasm and knowledge during fieldwork and laboratory work. We would also like to thank the five volunteers who offered their time and skills for identifying, measuring and counting thousands of individual plant species, namely Shirley McLaran, Ian Mathewson, Laura Williams, Kim Phillips and Isabella Ayres. We would also like to thank Susan and Wayne Somerville for giving us access to their property and showing us where their initial monitoring plots were placed. The University of New England funded this research.

References

Donahue M. J., Desharnais R. A., Robles C. D. and Arriola P. (2011) Mussel bed boundaries as dynamic equilibria: thresholds, phase shifts, and alternative states. *The American Naturalist* **178**, 612–625.

Duggin J. A. and Gentle C. B. (1998) Experimental evidence on the importance of disturbance intensity for invasion of *Lantana camara* L. in dry rainforest–open forest ecotones in north-eastern NSW, Australia. *Forest Ecology and Management* **109**, 279–292.

Gooden B., French K., Turner P. J. and Downey P. O. (2009) Impact threshold for an alien plant invader, Lantana camara L., on native plant communities. *Biological Conservation* **142**, 2631–2641.

Leseberg N. P., Lambert K. T. A. and McDonald P. G. (2014) Fine-scale impacts on avian biodiversity due to a despotic species, the bell miner (Manorina melanophrys). *Austral Ecology* **40**, 245–254.

Maron M. (2009) Nesting, foraging and aggression of noisy miners relative to road edges in an extensive Queensland forest. *Emu* **109**, 75–81.

Somerville S., Somerville W. and Coyle W. (2011) Regenerating native forest using splatter gun techniques to remove Lantana. *Ecological Management and Restoration* **12**, 164–174.

Stone C., Kathuria A., Carney C. and Hunter J. (2008) Forest canopy health and stand structure associated with bell miners (*Manorina melanophrys*) on the central coast of New South Wales. *Australian Forestry* **71**, 294–302.

Supporting Information

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

Appendix S1. Comparative images of the study area.

© 2016 Ecological Society of Australia and John Wiley & Sons Australia, Ltd