doi: 10.1111/emr.12391

Short Report

Efficacy of intervention to relieve nest box competition for Orange-bellied Parrot *Neophema chrysogaster*

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Key words: *competition, conservation management, tree cavity, Tree Martin, Petrochelidon nigricans.*

Summary

We use an experimental approach to evaluate the effectiveness of removing nests of a dominant competitor to create vacant nest boxes for a critically endangered parrot. We compared the number of times that Tree Martin (*Petrochelidon nigricans* – the dominant competitor at nest boxes) perched at or entered nest boxes intended for Orange-bellied Parrot (*Neophema chrysogaster* – the subordinate nest competitor) over three time periods (before, immediately after and one week after experimental nest destruction). In the before period, rates of nest attendance by martins in treatment and control nests were not explained by treatment group. After experimental nest destruction, total attendance at boxes by martins rose to a mean of 6.1 visits over three five-minute surveys in the treatment group, compared with 3.3 visits at control boxes. Within individual surveys, martins visited treatment boxes 4.4 times per survey one week after nest destruction, compared with only 1.6 visits in the control group. Martins in the treatment group rapidly rebuilt their nests and laid replacement clutches, and within a week, all boxes were reoccupied. Nest destruction did not increase nesting opportunities for the parrot, and increased vigilance of the dominant competitor may in fact reduce nesting opportunities in nearby boxes. Our study suggests that removing martin nests is an ineffective management action for alleviating nest competition for this parrot.

Introduction

Tree cavity abundance can limit the populations of cavity-dependent fauna (Newton 1994), and in some forests, cavities suitable for wildlife are rare (Stojanovic, *et al.* 2012). In such cases, competition among cavity-dependent species may be intense (Pearce, *et al.* 2011). If subordinate hollow competitors (i.e. those that lose competitive interactions) are of conservation concern, exclusion from cavities by dominant competitors may be a threat. Nest boxes are commonly deployed to overcome cavity limitation (Lindenmayer, *et al.* 2016), but if these are also occupied by dominant competitors, management may actually be creating new problems (e.g. if dominant species population sizes are inflated by additional nesting opportunities). Additional interventions to control dominant competitors (Stojanovic, *et al.* 2018c, 2018) may be necessary to protect threatened subordinate species, but the efficacy of these techniques may vary among species and study systems.

We evaluate whether removing nests of a competitor from nest boxes benefits Orange-bellied Parrot (*Neophema chrysogaster*, hereafter: parrot). It is arguably the rarest parrot in the world because in 2016 the wild population declined to only two females (Stojanovic, *et al.* 2018), and the species currently depends on nest boxes for breeding (Department of Environment Land, Water & Planning 2016). Anecdotal observations indicate parrots are subordinate to Tree Martin (*Petrochelidon nigricans* hereafter: martin) at nest boxes (Department of Environment Land, Water & Planning 2016). Martins are cavity-nesting aerial insectivores, and although smaller (18 g vs. 45 g), they can aggressively swoop at parrots until they are driven away from boxes (Department of Environment Land, Water & Planning 2016). Martins can also usurp parrot nests by covering-over their eggs with nests of leaves or by using mud to shrink the nest box entrance hole. On an ad hoc basis, conservation managers remove martin nests by cleaning nest boxes to alleviate competition, but whether this increases the availability of vacant boxes is unknown. We test this experimentally and evaluate whether nest attendance by martins (as a proxy for the intensity of box defence) changes after nest removal.

Methods

At Melaleuca, Tasmania, parrots are managed by the Tasmanian Government by provision of nest boxes and supplementary food (Troy & Kuechler 2018). Nest boxes have internal dimensions of 55 cm length × 15 cm height × 14 cm width with a 5 cm entrance hole, and 38 boxes are deployed on trees or wooden poles in the study area (more are deployed> 1.5 km away). Most trees support two boxes, but poles have only one box each. In December 2018, when most parrots were either prospecting for nests or incubating eggs, we randomly assigned 21 martin occupied nest boxes to either a treatment or control group (10 treatment, 11 control). Tree Martins begin building their nests early in the parrot breeding season, but timing of egg laying can vary from mid-spring to late summer (D.S. personal observation). Occupancy was confirmed by climbing trees and checking for martin nest cups in boxes. The treatment was implemented after the commencement of incubation and involved removal of nest material from boxes and destruction of eggs. We recorded data over three observation periods, timed around the day of the implementation of the treatment: (i) day before/morning of, (ii) day of/morning after and (iii) one week after. All nests were climbed once during each observation period to confirm martin nest occupancy. Treatment nests were destroyed during the second climb. During each observation period, we conducted three repeated randomly timed five-minute surveys of each nest box (total nine surveys per box). During surveys, we tallied the number of times martins landed on the entrance perch or entered a nest box. Observers were blind to the treatment applied at each box. We did not attempt to distinguish among individual birds. Surveys were conducted in the morning or afternoon.

Analytical approach

We calculated (i) the total number of times martins perched at/entered boxes cumulatively over the three survey periods and (ii) the maximum number of times martins perched at/entered boxes during an individual observation per survey period.

We used these values as response variables in generalised linear models and fitted the following fixed effects: (i) treatment group, (ii) survey period and (iii) an interactive effect of treatment group × survey period.

We evaluated nest box vacancy by checking martin occupancy of boxes one week after treatment implementation. Nest success (successful nests produced at least one fledgling) was compared among treatment groups using a binomially distributed generalised linear model. This model was compared against a null. We compared models using ΔAIC > 2, and all analyses were undertaken in R (R Development Core Team 2017).

Results

All nests contained eggs at the start of the experiment, and 4/11 control nests contained chicks at the end. None of the treatment group nests contained chicks during the experiment.

The best model for the total number of times that martins perched at/entered nest boxes cumulatively over the survey period contained an interaction between treatment group and survey period (Table 1). Based on that model, the total number of times martins visited boxes increased with each successive survey period in the treatment group, but was constant in the control (Table 2). The best model for the maximum number of times martins perched at/entered boxes during individual surveys in each period also contained an interaction between treatment and survey period (Table 1). Based on that model, the maximum number of times martins visited boxes increased with each successive survey period in the treatment group, but was constant in the control (Table 2).

Within a week of nest destruction, all martins in the treatment group had reconstructed nests and 8/10 had laid replacement clutches. The model including treatment group fit the data better than the null (ΔAIC 2.56), and nest success in the treatment group was 0.5 ± 0.2 (LCI: 0.2, UCI: 0.8) compared with 0.9 ± 0.1 (LCI: 0.5, UCI: 1) in the control group.

Table 1. Competing models ranked by AIC for the maximum and total number of times martins perched at the entrances of nest boxes

Response variable	Model	AIC	d.f.
Maximum	Treatment × survey period*	238.50	6
	Survey period	255.95	3
	Treatment	263.89	2
	Null	272.03	1
Total	Treatment × survey period*	296.12	6
	Survey period	317.26	3
	Treatment	345.21	2
	Null	353.56	1

Table 2. Modelled estimates on the original scale ± standard error (lower confidence interval – upper confidence interval) from the best fitting models for the total and maximum number of times martins perched at/entered nest boxes in the study

Response	Group	Day before/morning of	Day of/morning after	Week after
Total number	C	1.9 ± 0.4 (1.2–2.9)	1.7 ± 0.4 (1.1–2.9)	3.3 ± 0.5 (2.4–4.5)
	T	0.7 ± 0.3 (0.3–1.4)	4.3 ± 0.7 (3.1–5.7)	6.1 ± 0.8 (4.7–7.8)
Maximum number	C	1.5 ± 0.4 (0.9–2.4)	1.5 ± 0.4 (0.9–2.4)	1.6 ± 0.4 (1.0–2.6)
	T	0.6 ± 2.4 (0.3–1.3)	3.0 ± 0.5 (2.1–4.3)	4.4 ± 0.6 (3.2–5.9)

C = control group (n = 11), T = treatment group (n = 10).

Discussion

Deployment of nest boxes for parrots is an important conservation action but competition with martins could be an important limitation to the effectiveness of this approach. Removing martin nests and eggs did not contribute to the management aim of increasing the number of vacant boxes potentially available to parrots. Martins in the treatment group perched at/entered boxes more often than controls. All treatment nest boxes were reoccupied, and nests were rebuilt within a week. Nest survival in the treatment group was lower than in the control group; however, because all nest attempts by martins involve construction of nest cups and vigilance against competitors, these nest boxes are effectively unavailable irrespective of the outcome of the nesting attempt. Other approaches may be more effective in relieving parrots from competition; for example, where nesting success of parrots is at risk, trapping and removal of martins may be necessary.

If suitable nesting sites are rare, interspecific competition may become problematic if subordinate competitors of conservation concern are denied breeding opportunities. However, it is important to evaluate the efficacy of management efforts designed to correct this problem. Our study suggests that removing martin nests is an ineffective management action for alleviating nest competition for parrots. Further study of martin behaviour would assist in determining whether nest destruction could have a perverse impact on parrots via increased defence of nearby nest boxes. Removal of adult martins or oiling eggs could also be tested to identify alternative management actions to maximise availability of vacant, undefended boxes for parrots.

Acknowledgements

This project was funded by 1609 supporters of the crowd-funding campaign 'Operation OBP', the Tasmanian Government Department of Primary Industries, Parks, Water and Environment and the Australian Government's National Landcare Program and National Environmental Science Program. The research was conducted with approval from the Australian National University Animal Ethics Committee (A2016/48) and the Tasmanian Department of Primary Industries, Parks Water and Environment (TFA17037).

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