doi: 10.1111/emr.12423

Short Report

Automated broadcast of a predator call did not reduce predation pressure by Sugar Gliders on birds

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Key words: *broadcast, landscape of fear, nest survival, pest management, predation.*

Summary

Fear may elicit behavioural and physiological responses in animals. We conducted a pilot study aiming to reduce bird nest predation in Tasmania by the introduced Sugar Glider (*Petaurus breviceps*) by broadcasting calls of predatory owls. We designed a solar-powered, automated weatherproof stereo for long-term call broadcast in a forest environment. This device may have useful applications in other environments where long-term call broadcast is required in remote field conditions. Call broadcast did not reduce the likelihood of Sugar Glider nest predation on either active bird nests or artificial nests baited with farmed quail eggs. If we elicited fear in Sugar Glider individuals with call broadcast, this fear did not result in behavioural changes that could be exploited to achieve the conservation objective of lower predation.

Introduction

Scare tactics (visual, auditory and olfactory) have historically been used with mixed results and are a potential approach to mitigate the impacts of pest animals in sensitive ecosystems (Suraci, *et al.* 2016). Scaring tactics utilize sensory cues to alter the behaviour of the target species and can substantially alter their interactions with other trophic levels (Suraci, *et al.* 2016). However, the challenges of implementing and monitoring scaring tactics in remote locations for long periods are a barrier to their wider utilization in conservation projects.

We report on a pilot study aiming to protect bird nests using predator call broadcast. In Tasmania, the Sugar Glider (*Petaurus breviceps*) is an introduced invasive species (Campbell, *et al.* 2018) and a major predator of bird nests including critically endangered Swift Parrots (*Lathamus discolor*) (Stojanovic, *et al.* 2014). Its impact creates a need for efficient, cost-effective methods to protect birds nesting in natural tree cavities. Sugar Gliders are prey for forest owls (Todd 2012) and respond with alarm to their calls when broadcast (Allen, *et al.* 2018). We test whether broadcasting calls of forest owls lowers predation by Sugar Gliders on bird nests and develop a solar-powered, automated weatherproof stereo for long-term call broadcast in a forest environment.

Materials and Methods

We monitored forty nest boxes at two locations in south-eastern Tasmania (Eastern Tiers: S42°13′, E147°47′ & Meehan Range: S42°49′, E147°24′) which have confirmed Sugar Glider populations and a history of bird nest predation (Stojanovic, *et al.* 2018). We monitored nest boxes in paired control/treatment arrays comprising 10 nest boxes each. Arrays were >400 m apart and nest boxes were randomly spaced within 100 m of array centroids. An automated call broadcast unit (see below) was installed near the centroid of treatment arrays. Owl calls were broadcast throughout the night and motion-activated cameras were installed on nest boxes to confirm occupancy and predator identity.

We monitored predation of all birds that nested in our boxes because they were all potential Sugar Glider prey (Stojanovic, *et al.* 2014). We manually inspected 14 nest boxes occupied by birds (birds only nested at the Eastern Tiers site) before and after treatment to confirm nest fates and we confirmed predator identity from camera images. Empty nests, or those containing broken eggshells or carcasses, were scored as failed due to predation (Sugar Gliders consume the egg contents, leaving empty crushed shells, which are distinct from eggs accidentally broken by incubating birds).

Next, we baited nest boxes with farmed quail eggs at both the Eastern Tiers and the Meehan Range sites to evaluate predation intensity with a larger sample of artificial nests. One quail egg per nest box was deployed for 14 days (excluding two boxes that had become occupied by Sugar Gliders) and predation was confirmed by checking for broken quail eggs and by reviewing camera images.

Stereo system and design

We designed a custom stereo that was autonomously continually powered, weatherproof and light-sensitive. Stereos comprised a lumens sensor (Stojanovic, *et al.* 2018), two marine grade amps facing opposite directions, a stereo unit (Response QM3815) and a 12V28A car battery encased in a marine-ply box coated with weatherproof paint. The system was powered by two 12V4A solar panels. An additional battery was added to trees with dense canopies to ensure constant power. When light levels fell below 20 lumens (after sunset), the stereo was activated and owl calls were broadcast.

Recordings of the Masked Owl (*Tyto novaehollandiae*) (Todd, *et al.* 2018) and Southern Boobook (*Ninox boobook*) (Morcombe & Stewart 2011) were broadcast. Sound file spectrograms and frequency levels were adjusted in Premiere Pro and adjusted to a similar output volume with no distortion. The sound files were exported as a 44.1 mHz mp3 file onto a SD card and broadcast at a volume of ~90 dB at 1 m. Broadcasts were audible to people within 100 m. Sound files were <15 seconds. In our initial nesting bird trial, Masked Owl calls were played at a rate of one call to 5 min of silence. In the artificial nest trial, both Masked Owl and Southern Boobook calls were interspersed randomly between silence periods ranging from one to 30 min.

Analysis

We fitted generalized linear models using nest survival (both for birds and quail eggs) as a binomial response variable (survived/failed). Birds settled at only one site, so we only considered the effect of treatment on nest survival. For the quail egg experiment, in addition to a null model, we fitted treatment type, study site and whether or not a bird had nested in the box during the earlier study as fixed effects. Models were compared using ΔAICc < 2 using ‘AICcmodavg’ (Mazerolle 2019) in R (R Core Team 2019).

Results

We recorded 14 bird nesting attempts (Tree Martin (*Petrochelidon nigricans*) = 9, Australian Owlet-nightjar (*Aegotheles cristatus*) = 1, Common Starling (*Sturnus vulgaris*) = 4). Nest predation by Sugar Gliders occurred at 12 bird nests (one Tree Martin nest and one Common Starling nest survived). The treatment and control arrays each had a surviving nest. The null model had a lower AICc (13.82) than the model containing the effect of treatment (AICc 16.37) indicating that the treatment did not explain the survival of bird nests. Based on the null model, the predation rate on bird nests was 0.89 (± 0.09 se, LCI: 0.57, UCI: 0.96).

Of the 38 quail eggs deployed in nest boxes, nine were eaten by Sugar Gliders. Six of these were in control arrays and three in treatment arrays. The model containing the effect of treatment (AICc = 45.67) was within ΔAICc < 2 of the null model (AICc = 44.76), indicating equivalent support for both models. We preferred the simpler null model which estimated survival of quail eggs as 0.23 (± 0.06 se, LCI: 0.12, UCI: 0.38).

Discussion

Protecting birds in natural hollows from Sugar Glider predation remains an important conservation challenge. Our study suggests that even if Sugar Gliders feared our owl broadcasts, this did not reduce their predatory behaviour on bird nests. It is possible that regular call broadcast habituated Sugar Gliders to our treatments, but confirmation of this possibility would require further study. Habituation is a limitation of scare tactics and could be controlled for by implementing gaps of days between treatments (Suraci, *et al.* 2016) or employing motion-sensor activated broadcasts (Thuppil & Coss, 2016). Factors, such as population density or food availability, may drive predatory behaviours of Tasmanian Sugar Gliders and these factors require further research because they remain unknown.

Our results affirm that Sugar Gliders are severe predators of birds and we report the first case of nest predation by Sugar Gliders on an Owlet-nightjar. We considered non-target impacts of our method to be low because our small study areas are only a fraction of the mean home range of the Masked Owl (Todd 2012). A pilot trial on Tree Martin nests found no effect of call broadcast on bird brood size or body condition (G. Owens unpublished data). Future predator call broadcast studies should include a fuller assessment of impacts to all wildlife within the study area.

We developed a new tool to broadcast calls autonomously in remote field areas. Our solar-powered stereo design proved suitable for long-term field applications and operated from December to February with virtually no maintenance. One caveat for field applications of our stereo design is that in forests, partially shaded solar panels may lower battery performance. We overcame this problem using multiple solar panels positioned in areas of maximal sunlight and by adding a second battery. The design of the stereo system may be easily modified to include, for example, a timer (if more specific timing is required for call broadcast than simple night/day schedules). Automated broadcast of predator calls has potential for management of problematic species but we illustrate that behaviour may not always result in avoidance and the desired conservation outcome.

Acknowledgements

This project was funded by an environmental offset paid by MACH energy, the Australian Government National Environmental Science Program and a travel award from the Australian Wildlife Management Society. The authors would like to thank C. Young, F. Alves, T. Watson and C. Johnson. 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 (TFA19168).

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