Science for Saving Species

Research findings factsheet

Project 2.2.2

Threatened Species Recovery Hub

National Environmental Science Programme

A new approach to excluding small nocturnal predators from nest boxes

Study context

Many species nest mainly or exclusively in tree cavities. However, tree cavities can be scarce and access to them competitive, and in some habitats deforestation has exacerbated the shortages. Nest boxes have consequently become an important conservation tool where breeding is limited by a lack of tree hollows.

However, in addition to a scarcity of tree hollows for breeding, some threatened species are also severely impacted by predation while they are in their nests. This is a significant problem for the Critically Endangered swift parrot which is seriously threatened by sugar gliders.

The sugar glider is a small (~120g) possum introduced to Tasmania in the 19th century. It is a major predator on small, cavity-dependent birds. As sugar gliders are of a similar size to the birds they can fit through the nest box openings. The scarcity of tree hollows is also bringing sugar gliders and nesting birds into contact more often. There is consequently an urgent conservation need to protect birds in nest boxes from sugar gliders.

To address this challenge, we have developed and trialled an automated, solar-powered door that can be attached to nest boxes for at least the duration of a three-month breeding season. A photosensitive trigger mechanism opens the door at dawn and closes it at dusk to prevent nocturnal predation. We opted for a light sensor rather than a clock because the days may range in length over the course of the three-month breeding season, especially at high latitudes.

Nest box showing the solar-powered door known as a "possum-keeper-outterer". Photo: Dejan Stojanovic

This device became known as a "possum-keeper-outterer" during fundraising activity (crowdfunding campaign 'Operation PKO'), as sugar gliders are key predators of threatened birds in our study sites in south-eastern Tasmania, and we refer to it hereafter as the PKO.

Trialling the PKO

We performed a field trial of the PKO on the tree martin. This species is cavity-dependent, and is an abundant occupant of nest boxes. It also suffers predation by sugar gliders.

We erected 60 nest boxes at three locations in south-eastern Tasmania between December 2017 and February 2018, with 20 boxes at each site. The three locations were Southport Lagoon, Meehan Range and Tooms Lake, which are each characterised by dry forests. These locations also have high densities of sugar gliders, and the presence of tree martins as well as swift parrots. Other small nocturnal predators, including principally the brush-tailed possum and Tasmanian boobook owl, were also present at all sites at the time of the study.

We chose the level of light that activates the open/close mechanism based on a trial of the PKO that preceded this experiment and using data on the first and last nest visitation by swift parrots, as detected by motion-activated cameras. We oriented the 60 nest boxes randomly so that the PKOs experienced a range of prevailing weather and light conditions.

Nest boxes occupied by tree martins at each site were randomly assigned to either a treatment group with a PKO (up to five nest boxes per site) or a control group without a PKO (all other boxes at the site). We deployed PKOs after the tree martins had started to construct their nests but before they laid their first egg, and monitored the nests

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Trialling the KPO (continued)

with motion-activated cameras attached at the same time within 20cm of the nest box entrance.

The trial of the PKOs had two main objectives: (1) to evaluate the efficiency of PKOs at protecting bird nests from predators, chiefly sugar gliders; and (2) to investigate whether the operation of the doors had any negative impacts on the birds. To test efficiency, our first objective, we recorded nest fate as either successful (with at least one nestling surviving to fledge) or unsuccessful (with no surviving nestlings). We confirmed nest fate and predation by sugar gliders by reviewing images from the cameras and manually inspecting nests for egg fragments and carcasses. To investigate our second aim of negative impacts of the PKOs on the tree martins, we recorded the clutch size of each nest as an index of reproductive productivity and observed the birds for obvious behaviours that indicate distress.

Tree martin eggs inside a PKO nest box. Photo: Dejan Stojanovic

Our results

We found that nest boxes fitted with PKOs had a significantly lower risk of nest failure than those in the control groups. PKOs improved nest success in the treatment group by 56% compared to the control group.

The sole cause of nest failure in the control group was predation by sugar gliders, which we determined by inspection of egg fragments and carcasses in the nest boxes and confirmed by viewing the camera images. These predation events involved the death of adult tree martins as well as of their eggs or nestlings. At six treatment nests, where sugar gliders were detected, cameras recorded an average of 5.3 unsuccessful predation attempts over the nesting period, while all of the control nests failed after a single predation attempt. We also observed brush-tailed possums visiting two nest boxes, but the PKOs prevented them from reaching into the boxes with their forelimbs or snouts. These results demonstrate clearly that the PKOs eliminated predation even in an environment where the predation risk is high and the predators persistent, and this in turn enabled successful nesting.

Three of the four nests that did not survive in the treatment group failed for unknown reasons (although we observed that they failed during bad weather, which may have impacted the survival of nestlings).

The fourth failed due to the PKO not opening due to battery failure following several days of cloudy weather and shading of the solar panel. To address this we added a second solar panel to the system, which resulted in the birds in that nest box making a successful replacement nesting attempt. The other PKOs worked correctly for the duration of the three-month study, which we were also able to confirm by the camera images.

The cameras occasionally recorded repeated opening and closing of the PKOs during overcast mornings and evenings. We were able to correct this by shortening the length of the wiring between the battery and boxes, which addressed the voltage drop in the cables.

Our results also show good outcomes for our second objective, an investigation of any negative impacts on the birds by the PKOs. First, the treatment group did not differ significantly from the control group in clutch size. This implies that the PKO does not have any negative impacts on the breeding activity of the birds. Further, we did not observe any obvious behaviours by the tree martins that indicated distress. They seemed unperturbed by the movement of the door, which is relatively quiet, and typically resumed bringing nesting material to their boxes within 15 minutes of the PKO being deployed.

Not every nest box in an area will be occupied by the target species of a conservation program; often, most boxes will be occupied by more common species. At present, as PKOs cost about $400 each a project may decide to only add PKOs to nest boxes after a target species has taken up residence.

We did not explicitly test for behavioural change by nest-building tree martins after PKOs were deployed on their nests, although the consistent clutch sizes between control and treatment groups implies that if there were behavioural changes they did not have adverse outcomes on breeding. Further investigation of behavioural changes may be warranted in the case of species that are more sensitive to disturbance. The potential phobia of such species could also be managed by pre-emptively deploying PKOs on all nest boxes, or deploying 'dummy' PKOs on all available nest boxes before switching to an operational unit when the target species occupies a nest box. The animals would then only have to tolerate the opening and closing of the door at first and last light.

Tree martin chicks. Photo: Dejan Stojanovic

Any subtle behavioural/physiological impacts of the PKOs that may have passed undetected in this study due to high predation rates could be investigated through replication of the experiment in a predator-free habitat. This may be particularly important in the case of future PKO studies of the swift parrot, which is Critically Endangered due to sugar glider predation, where any behavioural/physiological impacts of the functioning of the PKO on the birds should be identified and weighed against the known risks of severe predation mortality.

Sample size of tree martin nests per site and treatment group, presented as number of failed nests/total number of nests

Site	Control	Treatment	Total
Southport Lagoon	7/8	0/5	13
Meehan Range	12/15	3/6[a]	21
Tooms Lake	7/8	1/5	13

[a]Two successive nesting attempts occurred in the same nest box.

Further Reading

Stojanovic, D., Eyles, S., Cook, H., Alves, F., Webb, M., & Heinsohn, R. (2018). Photosensitive automated doors to exclude small nocturnal predators from nest boxes. *Animal Conservation*. doi: 10.1111/acv.12471

Conclusions

Our findings show that the PKO represents a useful new conservation tool for targeted nest protection against nocturnal predators.

The solar panel means that they are suitable for reliable use over long periods – such as a three-month breeding season. They are a low-maintenance tool, which is essential for remote locations, such as key areas for the protection of threatened birds in Tasmania. After initial checking and positioning of the solar panels away from shade to ensure that the battery charge is being maintained, the PKOs require only intermittent checks of battery voltage. Further, the PKO is scalable, so it can be designed to protect against predators of different sizes.

Another versatile feature is that it can be designed to close during the day and open at night to protect nocturnal species that are vulnerable to diurnal predators, or to allow nest boxes to be used as a trap for researching nocturnal animals. It is also simple to manufacture.

Together these advantageous features will enable conservation programs to overcome the significant risks posed by predators that can breach the protection measures of traditional passive nest boxes. It can be particularly important to protect animals in nest boxes against predators in projects that require high survival of the target species, such as Critically Endangered birds like the swift parrot.

Tree martin chicks and adult killed by sugar gliders. Photo: Dejan Stojanovic

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