

Learning from the outcomes of a nest box program

Biodiversity offsets and nest boxes

Most Australian governments, and many around the world, now require developers to compensate for habitat and other environmental loss. The most common mechanism used for this is biodiversity offsetting.

In Australia, under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) developments are required to avoid and mitigate impacts to Matters of National Environmental Significance, including species listed as threatened under the Act. If significant impacts cannot be avoided, a biodiversity offset is often required to compensate for the environmental impacts, so that 'no net loss' is achieved. Biodiversity offsets can also be required under state and territory environmental legislation.

A commonly used offset technique in developments where hollow-bearing trees are removed is installing nest boxes to provide substitute nesting and denning sites for environmentally significant species. The effectiveness of nest boxes as a substitute has not previously been well assessed.

This research has monitored and assessed the effectiveness of a nest box program implemented by the New South Wales (NSW) Roads and Traffic Authority, in an area where a large number of hollow bearing trees were removed to make way for widening of a major road. The findings are of relevance to any programs where nest boxes are proposed to mitigate for the impacts of hollow bearing tree loss.

The Hume Highway nest box program

The Hume Highway (which links Sydney and Melbourne) was widened over 140 km between Holbrook and Coolac in NSW. The widening involved clearing thousands of trees which provided denning, breeding and foraging habitat for threatened species listed at state and/or national level, including the superb parrot, brown treecreeper and squirrel glider. Nationally Critically Endangered white box–yellow box–Blakely's red gum grassy woodland and derived native grassland (box gum grassy woodland) ecological community was also cleared.

The NSW Roads and Traffic Authority implemented an offset-like program in the areas to mitigate and compensate for environmental impacts. One of the actions involved installing 587 nest boxes, equivalent to the number of tree hollows estimated to have been lost. The nest box program had a total expenditure of \$278,517.

Many of the boxes were specifically designed for three target threatened species: the superb parrot, brown treecreeper and squirrel glider. They were also diverse in their design, in terms of the size of their entrances and their volumes, to match the loss of a range of hollow types. Replacement trees were also planted in surrounding areas but it takes more than 120 years for the trees to develop natural hollows that are suitable for nesting and denning by these species.



Nest box checking. Photo: Daniel Florance

Focus of the research

A team led by the Australian National University monitored the nest boxes for four years from installation under contract from NSW Roads and Maritime Services. The monitoring data enabled the team to investigate whether nest boxes were effective compensation for the clearing of large old hollow-bearing trees for the three target species, and also to determine the overall use of the boxes by other species.

The developer conducted pre-clearing surveys of the impacted habitat, but did not make the data available to the research team. The numbers of the three species nesting in tree hollows at the site before the development project was therefore unknown, although the research team drew on data from adjoining areas and other sources to estimate the pre-clearing numbers of superb parrots, brown treecreepers and squirrel gliders.



Possums in nest box. Photo: Mason Crane



*Superb Parrot emerging from tree hollow.
Photo: Dave Curtis*

How the research was undertaken

For four years from 2010 to 2013, the team monitored the 324 nest boxes that could be safely inspected. Of those, 83 were designed for squirrel gliders, 77 for brown treecreepers and 37 for superb parrots. The team also monitored other kinds of nest boxes: 62 for bats, 42 for the common brushtail possum, 13 for the common ringtail possum and 10 for large birds.

Nest boxes were inspected in the spring of 2010, 2011, 2012 and 2013 and the summer of 2011 and 2012. This made a total of 2485 individual checks of nest boxes over the four-year duration of the study. During each survey, the team recorded the physical presence of animals and signs of them using the nest boxes,

such as scats, hair, feathers and nests. When it was necessary, they sent samples for expert identification of the species. In addition to recording occupancy and by particular species, they recorded whether the boxes were intact and capable of being occupied.

As part of the investigation of nest box effectiveness, the team compiled information on the costs of the program. The information was obtained from the New South Wales Roads and Maritime Services in 2010 Australian dollars for pre-establishment strategic planning, nest box construction and post-establishment monitoring.

Key findings

The three target species made very little or no use of the nest boxes.

The **superb parrot** made no recorded use of the nest boxes, including the boxes specifically designed for the species. This was despite the superb parrot being present in the surrounding areas.

The **squirrel glider** used just seven of the 324 nest boxes monitored in the study, and only one of these was a box specifically designed for the species. The team found that the glider's rate of use of nest boxes was lower than the rates recorded for nesting in large old hollow-bearing trees within the denning range of individuals in a comparable survey period. The implications of this are that to offset the loss of nesting sites for the squirrel glider, at least five trees with a suitable nest box are needed for each hollow-bearing tree destroyed.

The **brown treecreeper** made use of just two nest boxes in one

survey period, neither of which was specifically designed for the species. This was despite the bird being present at 22% and 33% of long-term sites surveyed in 2011 and 2013, respectively.

Overall use of nest boxes by all species

Over the four-year duration of the study, for any survey period, between 44.7% and 65.1% of nest boxes either were occupied by an animal or showed signs of use. A total of 17 species was recorded occupying the 324 nest boxes, of which four were exotic: the feral honeybee, the black rat, the house mouse and the common starling.

The species most commonly recorded were, in descending order, the yellow-footed antechinus, the common brushtail possum, the feral honeybee, the black rat, the common ringtail possum and the common starling. The nest box program therefore performed best for

providing alternate hollows for common native species and were also frequently used by invasive species.

Nest box failure

Twenty-seven of the 324 nest boxes, or approximately 8%, became ineffective over the four-year study period. The main reasons for this were boxes falling from trees (14 boxes) and presumed theft (7 boxes). At this rate, all the nest boxes would be lost within 50 years.

Estimated costs of the nest box program

The total cost of establishing and monitoring nest boxes under this program was estimated to be AU\$278,517. Of this, just over half (54%) was spent on the construction and installation of the nest boxes. Over a quarter (28%) was spent on monitoring and the remaining 18% was spend on project planning.



Collapsed Nest box. Photo: Sachiko Okada



Brown Treecreeper. Photo: Dave Curtis

Recommendations

This project set out to close a knowledge gap about the effectiveness of the use of artificial hollows to mitigate lost natural tree hollows due to development. This was important work because, despite a lack of empirical assessments of these kinds of programs, their use is rapidly increasing worldwide. Our monitoring and analysis shows that the nest box program established along the Hume Highway was not sufficient to mitigate the impacts of development on the availability of nesting sites to hollow-nesting wildlife.

A key finding was that the three threatened target species made very little or no use of the nest boxes, especially when compared to their use of large old hollow-bearing trees nearby. As such, the nest boxes have been ineffective substitutes for lost tree hollows for these animals.

The following lessons can be drawn from this project to improve the effectiveness of other future programs where nest boxes are used to replace lost tree hollows:

1. The ratio of one-to-one for nest boxes to tree hollows was inadequate. Our analysis clearly shows that far more boxes are needed to replace the natural hollows that are lost to development.

2. Given the rate of attrition of the nest boxes, there should be a requirement for developers to not just install nest boxes but also to replace them as they degrade over time. It can take over 120 years for trees to develop natural hollows suitable for cavity-dependent fauna. To ensure the loss of hollow-bearing trees is genuinely compensated, thousands of boxes may be required over periods longer than any person's lifetime. An estimate of the cost of sustaining the Hume Highway nest box program until natural tree hollows become available is \$26.9 million in 2010 Australian dollars. This shows just how valuable natural hollows can be – they are very expensive to replace!

3. Nest boxes cannot replace many of the values of large old trees. Such trees have a wide range of ecological roles beyond habitat provision for hollow-nesting fauna.

For example, they are important for carbon storage and generating large pulses of flowers for honey production and the beekeeping industry. Where it is possible, we should avoid destroying these keystone structures in the environment.

4. When it is not possible to protect key features like large old hollow-bearing trees, biodiversity offsetting should make use of more holistic strategies, such as promote natural regeneration to assist the long-term replacement of old trees. This strategy could complement adequate maintenance and monitoring of nest boxes over the long term.

It is important to note that in offset programs, at present developers are usually only required to establish the offset actions (e.g., erect the nest boxes) not to monitor, maintain or achieve intended objectives. To improve the outcomes from offsetting programs, a shift in public policy may be necessary to mandate not only the implementation of offsetting and use of outcomes-based conditions but also that enduring ecological outcomes are achieved.

Squirrel Glider (night camera). Photo: ANU



Cited material

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Further Information

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