Local Land Services
Greater Sydney

# Hollows For Habitat Forum
## PROCEEDINGS


Newington Armory, Sydney, 20th May 2015

SydneyOlympicPark

Australian Government

This event was coordinated and delivered by Greater Sydney Local Land Services with funding from the Australian Government. It was made possible due to the generous support of Sydney Olympic Park, and the contributions of presenters.

Proceedings compiled by Jenny Schabel, GS LLS

## Contents

# Foreword

Greater Sydney Local Land Services is pleased to have had this opportunity to convene the Hollows for Habitat Forum on 20th May 2015, in partnership with the Sydney Olympic Park Authority.

This forum has brought together 200 delegates from state and local government, arborist, bush regeneration and ecological consultancies, universities, Bushcare groups, and wildlife carer groups from across Greater Sydney to share information on installing nest boxes, pruning for hollow habitat and augmenting woody debris to enhance habitat for native fauna. It has been an opportunity to consolidate lessons learned and showcase new innovations.

There is a clear need for improving habitat for a wide range of important animal species across Greater Sydney, as well as for knowledge to be shared about what has been proven to work. It is also clear that much more research is needed into the future.

We are thankful for the expertise and collegial spirit of the contributors to this forum and we hope that the knowledge and experience compiled in these Proceedings will help to inform best practise bushland enhancement for the benefit of our native fauna across Greater Sydney and beyond.

To the delegates who attended I thank you for your support and interest in this forum. Your own commitment to making a positive difference to our natural environment here in Greater Sydney is strongly shared by my team here at Greater Sydney Local Land Services.

Greater Sydney Local Land Services is a one-stop agency, providing agricultural advice, pest control, biosecurity, natural resource management and emergency management services. For more information about Greater Sydney Local Land Services' natural resource management and other programs visit www.greatersydney.lls.nsw.gov.au or phone one of our offices listed below.

David Hogan

General Manager, Greater Sydney Local Land Services

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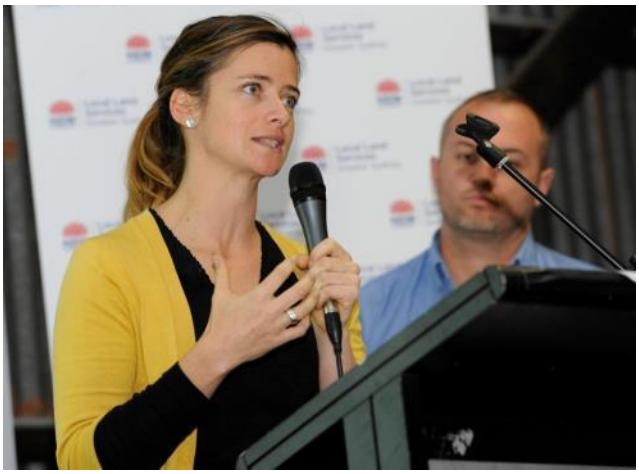
## Forum Snapshots – 20th May 2015

One of the morning presentations held in the Newington Armory Theatre.



Sophie Golding from City of Sydney Council and Gwilym Griffiths from Marrickville Council sharing experiences from their Habitat Stags and Logs projects.

Fauna ecologist Narawan Williams showing attendee Lachlan Wilmott some design innovations of his modified nestboxes.


Greater Sydney LLS staff on hand to help the day run smoothly.

Arborist Pat Kenyon from Tree Tactics Victoria giving a chainsaw demonstration of pruning trees for habitat.

Glenda Clark from Sydney Wildlife and other participants enjoy a nest box walk through Newington Woodlands reserve, led by fauna ecologist Narawan Williams and Sydney Olympic Park Authority ecologist Tina Hsu.

# Why monitoring matters- Case study of hollow augmentation for microbats in Cumberland plain reserves - Dr Tanya Leary,

**Biodiversity & Wildlife Team, Park Conservation & Heritage Branch, OEH**
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Monitoring artificial habitat augmentation is vital to ensure that management objectives are being met. Despite the vast literature on box designs for birds and microbats, most recommendations are based on little to no understanding of species preference, or use studies from within limited geographic zones. Contrary to popular opinion, we do not have the level of understanding needed for most hollow-dependent microbats and birds. Most species preferences are only broadly described and almost all are still poorly understood. Increasing this understanding is critical if artificial hollows are to be used for conservation of species in landscapes where loss of hollow-bearing trees exceeds natural recruitment. Better understanding of target species is needed, particularly their selection of natural tree hollows, and preferences for design elements and placement of artificial hollows. This can only be achieved by detailed studies of natural tree hollow-use, and a commitment to monitoring artificial hollow-use. Although monitoring is expensive, so is wasting money on management actions that don't achieve the desired management objectives.

When monitoring, occupation of artificial hollows alone is not evidence of management success, particularly if it is sporadic, and/or they are not used by key components of the population such as breeding females and young or at key times of year e.g. over winter. More appropriate measures of management success might include on-going use, successful breeding events, and population increases.

**Background to hollow-augmentation studies on the Cumberland Plain**

Systematic surveys of NPWS reserves on the Cumberland Plain revealed that 41 native mammal species remain, but many are known from only 1-2 reserves. Twenty of these species are microbats which are probably amongst the most abundant of the native mammals remaining. Sixteen microbat species are either completely hollow-dependent for roosting or may occasionally utilize hollows.

Three of the microbat species (Photos by A. Kwok).

NPWS reserves in Western Sydney are small and poorly connected remnants of less than 1000 ha, yet are amongst the largest patches of bushland remaining in these landscapes. Much of the vegetation within these reserves is regeneration <60 years old, so hollow-bearing trees are scarce and competition for them is probably high. There is also likely to be a substantial time-lag in the natural recruitment of tree hollows due to the preponderance of small versus large trees, and this paucity is exacerbated by the continuing loss of large hollow-bearing trees. On-going hollow loss within and outside of reserves on the Cumberland Plain is occurring at an alarming rate, due to development, public safety concerns, weeds particularly vines, wildfire, arson and natural senescence. There is a clear need to try to address this paucity of hollows to reduce the risk of further species decline.

**Study of artificial hollow augmentation for microbats in Scheyville National Park and Prospect Nature Reserve**

The objectives of this study are to: 1) explicitly test the assumption that the bat population is limited by tree-hollow availability; and 2) examine some factors which might influence occupation/usage of bat boxes.

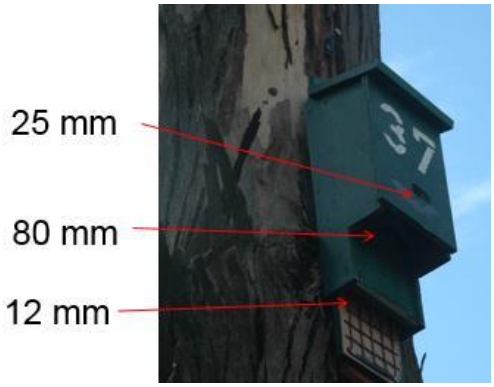
Ten 2-ha sites (5 control and 5 augmented sites) have been established within the two reserves. A pre-augmentation survey using harp traps and bat detectors in Spring 2010 assessed microbat relative abundance and activity at all ten sites. In Autumn 2011, 30 bat boxes of 3 different designs were installed in each of the 5 augmented sites (a total of 150 boxes). Temperature and humidity ibutton loggers were installed in 65 boxes and on 35 trees, and microhabitat assessments undertaken at each bat box and bat-detector location. Boxes have been monitored monthly, from 4 months to 47 months after augmentation (34 times over 44 months). Harp trap and bat detector surveys were repeated under similar conditions in Spring 2011 (6 months after augmentation), Spring 2012 (18 months), and Spring 2014 (42 months).


In red, Scheyville National Park to the north, and Prospect Nature Reserve to the south.

**Bat box types**

Three bat box designs were used:

1) *Open bottom boxes* - with three opening sizes (12, 25, 80 mm) and two chamber widths (12 and 80 mm) were paired (NE and SW) at three heights (3-3.5, 6 & 9 m above ground) on two trees per site, totalling 60 boxes across the five sites on 10 trees.




Open bottom boxes with three opening sizes and two chambers.

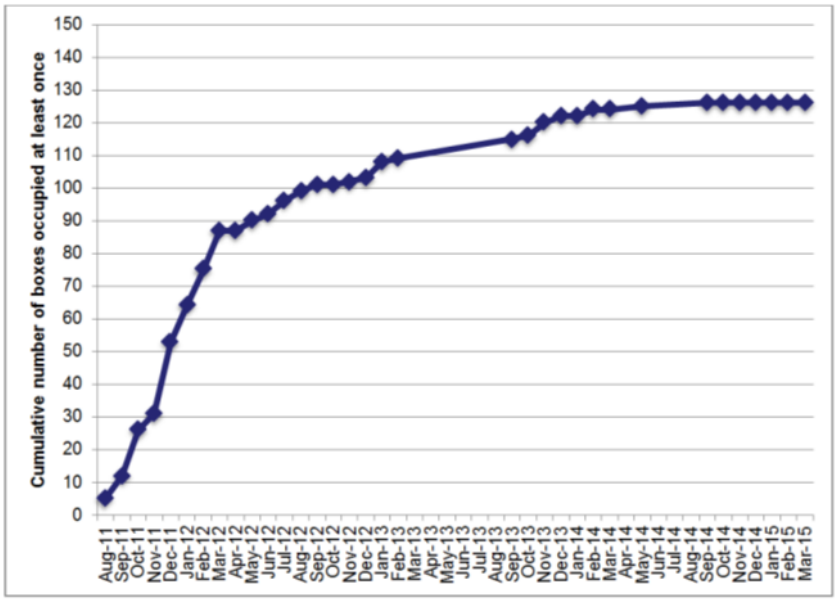
2) *Closed bottom boxes with bottom entrance slits* – Forty thick (40 mm) and forty thin (18 mm) timber boxes; half of each timber thickness with narrow bottom entrance slits (12-15 mm) and half with wide slits (18-20 mm). These were paired (NE and SW) on 40 trees across the sites at 3-3.5 m above ground.

3) *Inverse U boxes* – 10 hardwood boxes (2 per site) with both a narrow chamber (~15 mm) and wide chamber (~60 mm) and which allowed bats to move between chambers and sides of the box. These had a volume of 4–5 times that of other boxes and were installed at 4 and 7 m above ground.


Inverse U box (left) and thick timber boxes with wide entrance slit (above).

**Bat-box occupation**

Use/occupation of the boxes was rapid, with feathertail gliders, seven microbat species, two frog and a skink species recorded. 126 boxes were occupied at least once, for a period of between 1 – 27 months (this includes occupancy detection from bat scats). The proportion of boxes occupied each month by microbats ranged from 5.3 to 31.3%. Individuals or groups of microbats were detected in 89 boxes. Occupation was extremely male biased (initially with many single or small groups of males) with no signs of any pregnant or lactating females through the first two breeding seasons. Lactating Gould's wattled bat *Chalinolobus gouldii* females with young were finally recorded in the third breeding season monitored, in only one box type: the Inverse U. After March 2014 two microbat species (*C. gouldii* and the eastern broad-nosed bat *Scotorepens orion*) occupied an increasing proportion of the bat boxes suggesting that they may have been excluding other species.




**Open bottom boxes**

Six species of microbat utilised these boxes, with only two species recorded at all three heights (the lesser long-eared bat *Nyctophilus geoffroyi* and the little forest bat *Vespadelus vulturnus).* Some species occupied a specific chamber of the boxes. Although up to four microbat species were recorded utilising an individual box, there was never more than one species in a box at a time. Occupation rates differed with height but not with aspect, and lower boxes were more frequently occupied. Some species specific preferences were apparent, for example larger *S. orion* groups tended to be at 3.5 m boxes with a SW aspect and occupied both the narrow and wider chamber.

**Closed bottom boxes with bottom entrance slits**

Seven species of microbat plus the feathertail glider occupied these boxes. Up to four species occupied an individual box, but only two boxes were ever occupied by more than one species simultaneously (*C. gouldii* co-occupied one box with the chocolate wattled bat *C. morio* and one box with *N. geoffroyi*). Monitoring showed that the number of times a box was occupied differed between entrance sizes, but not between timber thickness and aspect. Boxes with wide entrances were occupied more frequently. Mean group size tended to be larger in thick timber boxes with wide entrances on a SW aspect. There were species specific preferences for entrance size and seasonal differences in preference for timber thickness and aspect for some species.

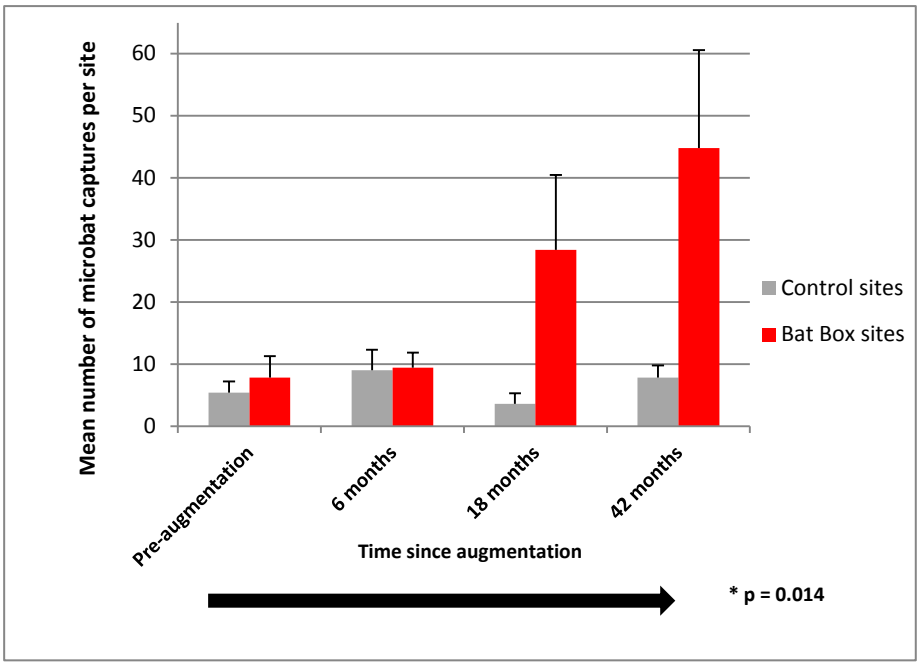
**Inverse U boxes**

Six species of microbat and the feathertail glider occupied these boxes. All boxes were occupied by between two and six species. Two species were recorded simultaneously occupying four boxes on six occasions (including co-occupation of microbats with feathertail gliders). These boxes supported the largest groups of microbats (up to 157 lactating females and young of *C. gouldii*).

Inverse U box occupied by a group of *C. gouldii* (left) and by feathertail gliders (right).

**Changes in relative abundance and activity**

Post-augmentation harp trapping revealed an increase in number of individuals captured at augmented sites relative to control sites by 18 months after augmentation, and an almost 6-fold difference by 42 months post-augmentation. Preliminary analysis of echolocation calls similarly suggests a difference in bat activity between control and augmented sites. *C. gouldii* and *S. orion* appear to be increasing disproportionately compared with other species at the augmented sites.




**Preliminary conclusions from the study:**

- Hollows are a limiting factor at Prospect and Scheyville, for at least two microbat species.
- During monitoring, it is important to ascertain the sex of occupants. High occupation rates could be largely male.
- An extreme male bias may suggest that the boxes are either sub-optimal habitat or females take longer to find them.
- Only one type of box has provided roosts for maternity groups of only one species, which is concerning as this is the most important component of the population.
- Augmentation may have unforeseen consequences in terms of affecting relative abundance and inter-species competition – there may be winners and losers.
- Augmentation for whole bat communities is going to require a variety of designs and design elements. Preferences are varied but still are not clearly understood for most microbat species.

**Further study**

Data analysis is yet to be completed, particularly with respect to the influence of microhabitat and temperature/ humidity on occupation of boxes. Monitoring will continue in the breeding season for signs of other species breeding. Further investigations are required to:

- Ascertain what makes Inverse U boxes attractive to breeding *C. gouldii* females (e.g. volume, ability to segregate, hardwood timber or aspect etc.).
- Determine the influence on occupation of aspect other than NE & SW, entrance positions & landing pad size.
- Determine whether similar responses to augmentation can be replicated at other sites, particularly regenerating woodland with no or little tree canopy.

**Take home messages:**

- Loss of hollow-bearing trees is coming to a critical point in some landscapes .
- Test nest box design elements and include adaptive management and monitoring, or augmentation will not fulfill it's potential as a conservation management tool.
- Occupancy alone ≠ management success.
- Monitoring for sex ratio and breeding is important (at least identify sex ratios once over the breeding season).
- Commitment to on-going monitoring is crucial.

I am extremely grateful to NPWS Cumberland Area staff (particularly Area Manager Jonathon Sanders) and volunteers for all their assistance in this study.

# Augmenting hollows – worthwhile or just warm & fuzzy?

**Peter Ridgeway, Senior Land Services Officer (Biodiversity), Greater Sydney Local Land Services** peter.ridgeway@lls.nsw.gov.au

**Volunteer – Wildlife Programs, Cumberland Land Conservancy**
www.cumberlandlc.org.au

Nest boxes, hollow pruning and log translocation are obvious ways to address the shortage of natural hollows. But how much do we know about the consequences? Are we really improving the prospects for the species that need it?

Many of Sydney's native wildlife species rely on tree hollows or hollow logs for their survival. These resources are in short supply and we cannot afford to wait for their natural replacement (Gibbons et al 2000). Nest boxes, hollow pruning and log translocation are obvious tools to address these shortages. But how do we know if our actions are creating the changes needed rather than simply a 'feel-good' fix? Does hollow addition risk making the situation worse for our wildlife by targeting adaptable, aggressive species at the cost of those most at risk? And does the ease of its use tempt us to neglect the protection of natural hollows?

Some questions to regularly raise are:

- What species are we targeting and why?
- Are we targeting the relative threats they face – including land-clearing?
- Are we operating at the scale necessary to deliver a material improvement? and
- How will we monitor to ensure our actions are making the difference we want?

**The housing crisis**

The Cumberland Plain region is indicative of the broader problems with hollow-availability in the Sydney region. Only a tiny fraction (6-11%) of the dominant ecosystem Cumberland Plain Woodland remains. Since European invasion we've lost at least two native flora species from this landscape (*Swainsona monticola* and *Thesium australe*). However in the same period we've lost dozens of fauna species.

Just how critical hollows can be is highlighted in the extinction of Antechinus in Cumberland Plain Woodland. The last confirmed population of *Antechinus* were animals trapped by Dr Kirsten Crosby in 2005 when assessing the residential development of a golf course. The animals were living in two isolated hollow-bearing Forest Red Gums *Eucalyptus tereticornis* located in the rough between two fairways. Just *two trees* retained a species for over a decade until their destruction.

Before we consider habitat augmentation we need to understand the problem in detail, including *why* we have a problem, *which* species are suffering and *quantifying* the deficit of structural habitat.

**Which species are suffering?**

A broader range of fauna than is typically considered rely on hollows. As other presentations will show the nature of hollow augmentation strongly influences which species are assisted; and in most projects to date the 'winners' are common habitat generalists – not declining species.

Tree hollows are not just roosts for possums and parrots; the endangered sandstone platform endemic Broad-headed Snake uses tree hollows for seasonal roosts. Likewise hollow logs are not just for mammal roosting – they act as critical foraging perch sites for a range of vulnerable woodland birds. Rarely are these 'ancillary' species targeted with hollow creation.

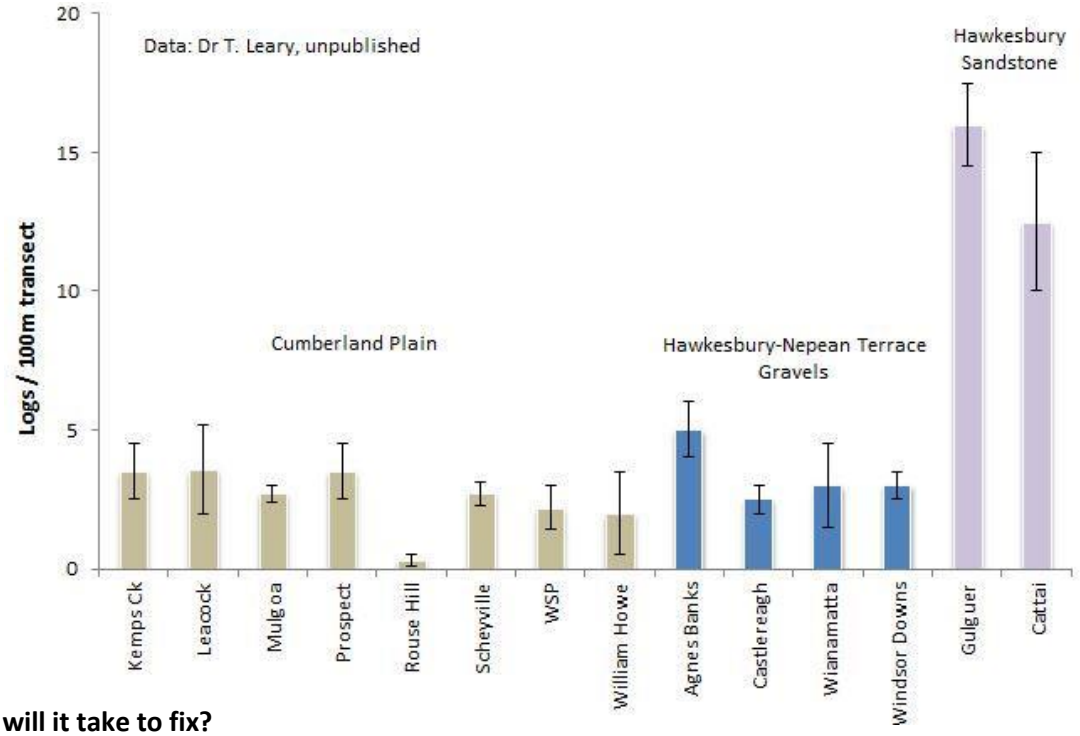
**Why is there a problem?**

We all know the reasons we are lacking in arboreal and terrestrial hollows:

- Land clearing
- Inappropriate fire regimes
- Firewood harvesting
- pruning for human safety (especially in urban areas or 'activated' reserves)
- Stick picking (including through bush regeneration)

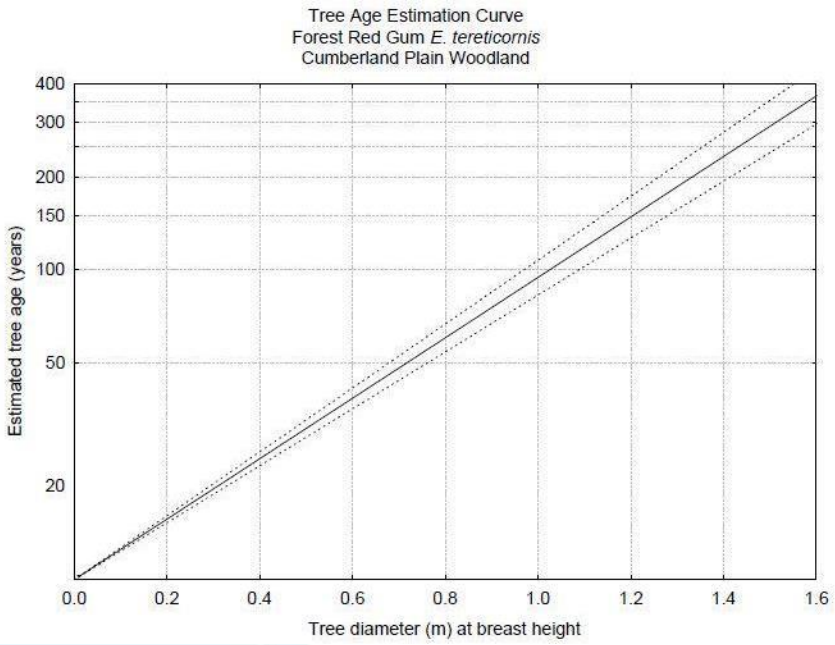
**How bad is it?**

The severity of impacts – and subsequent response - differs by region and landscape. For the Cumberland Plain the shale communities in particular have a history of severe misuse reflected in the lack of terrestrial woody debris (below). This is reflected in the severe lack of small ground mammals in Cumberland Plain Woodland, Blue Gum High Forest and Turpentine Ironbark Forest. This fauna guild and these communities should therefore be the priority for intervention.




**How long will it take to fix?**

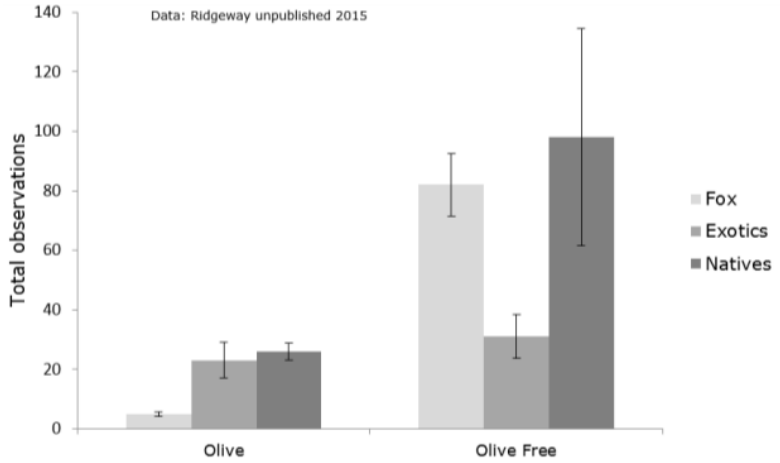
It takes a very long time to grow a hollow. Tree growth and hollow development are slow but rates vary with locality and species. For example in Cumberland Plain Woodland the CLC have calculated growth rates for a number of species. Forest Red Gum *Eucalyptus tereticornis* (below) takes around 100 years to reach 1 meter diameter at breast height – the point at which many hollows form.




These growth rates dictate not only the availability of arboreal hollows but the availability of hollow logs as well - every hollow log begins life as the branch of an old tree.

**Fixing one problem can cause another**

Before we intervene we need to consider potential compounding problems. An obvious one is the link between foxes and coarse woody debris - any farmer can tell you that foxes love woody debris too. Foxes are positively correlated with other habitat improvements such as the removal of African Olive (below). So to make most of hollow log augmentation it needs to be combined with fox control.




Species dominance is another pitfall. The species for which habitat is created are not the only species likely to use it. The potential negative impact of boxes on other species via competition or predation by Brush-tailed Possum is a well-known example. Another is the Goulds Wattled Bat *Chalinolobus gouldii* as considered in the presentation by Dr Tanya Leary.

**Ongoing hollow loss**

Hollow augmentation provides a tool to mitigate the historic losses of the past – and like all mitigation it is frequently misused to justify repeating the mistakes of the past. It's critical to remember *why* we have a problem. No technology can replicate the physical attributes of a hollow (such as temperature and humidity) and only a proportion of our native species choose to breed in augmented hollows. While a hollow tree may live hundreds of years and self-replace even the best next boxes fail within a decade or two of installation. Nest boxes by their nature can never justify or offset the loss of natural hollows. We must learn to acknowledge the limitations of augmented habitat. Failure to do so risks undervaluation of our natural hollows resource and increased acceptance of hollow destruction. Environmental arboriculture (including hollow augmentation) is still developing in Australia. However the techniques displayed today including crown retrenchment pruning and companion under-planting offer real solutions to reducing the loss of our *existing* hollows. In western Sydney native groundcovers beneath trees has shown to be critical to the life cycle of predatory insects which control pests including the Grey Box Psyllid which has caused extensive dieback.

**Scale**

Nest box designs are often categorised as 'successful' or 'unsuccessful' for a target species. To be successful we need to move beyond these simplifications to question *how frequently* and *in which life stages* a target species uses a box design, the *impacts of other species* using the box, and the realistic *lifespan* of the boxes. A development-funded restoration industry means that single instance occupation by target species (e.g. large forest owls) rapidly enter the textbooks as generic 'successes' – when in reality these are 'scale failure' examples. Most species rotate roosts and the minimum nest box or hollow log abundance needed to achieve a meaningful impact may be considerably greater than assumed as demonstrated in the CLC habitat log program. The length of use is another key consideration – especially given the loss of existing 'permanent' hollows in which most projects operate.

**Monitoring**

The last consideration is for monitoring. As demonstrated there are many avenues through which hollow creation programs can fail or result in unexpected negative ('perverse') outcomes. Without adequate

monitoring it is not possible to determine whether our efforts are improving or in fact exacerbating the problems for the diversity of native wildlife. While practical constraints cannot be ignored the risks of negative impacts from hollow addition make unmonitored projects highly undesirable.

**Example – Cumberland Land Conservancy habitat program, Mulgoa**

This CLC project is a partnership between private landowners, Mulgoa Valley Landcare Group, Penrith City Council, Sydney Water, Greater Sydney Local Land Services (GS LLS), University of Western Sydney and Office of Environment & Heritage (OEH). Target species were small ground mammals and in particular Bogul (*Rattus fuscipes*). This selection was based on the results regional biodiversity monitoring by OEH & GS LLS, which suggested this guild and species as suffering dramatic declines in the last two decades. The project site at Mulgoa was targeted as supporting one of the last regional populations. The species targeted face a range of threats including land clearing, loss of terrestrial hollows and predation by the Red Fox. In view of the interaction between fox and terrestrial hollows the hollow addition was undertaken in conjunction with regional cross-tenure fox baiting.

It was critical to achieve a meaningful scale and this project demonstrates just how considerably this can be for even small gains. Bogul have a variable home range of between 0.4 – 1.6 hectares. To support at least 10 - 20 individuals (an absolute minimum outcome) required restoration of at least 15 hectares of habitat. Data from other grassy woodlands suggested a target of 20 tons/ha of woody debris (primarily larger logs) for optimum habitat of similar species. On this basis we required about 350 tons of logs to make a small population recovery possible.

Hollow logs reinstated in Mulgoa Nature Reserve.

To date over 40 tons of logs have been installed across both private land and Mulgoa Nature Reserve. Logs were rescued from local developments and laid by truck in accessible areas and by helicopter in less accessible areas. All materials and work (including helicopter support) were donated by the project partners. While this 40 tons outcome is very large for a log addition project this constitutes just 10% of the material needed for the very modest target outcome. CLC have been working hard on a program to install the remaining 300 tons and now have the materials and funds secured to begin this stage in the latter part of 2015.

Lastly it is critical to monitor the impact of the project on the target and other species. The site has been split into two adjoining ridges, with one receiving logs (the treatment) and one left as-is (the control). This will allow us to confirm if any changes observed are due to the log addition or to other landscape-level changes. The CLC in association with UWS have installed a wildlife camera grid on private property to monitor the native wildlife over time. The NPWS have also undertaken baseline small mammal trapping in the Mulgoa Nature Reserve and will undertake a 12-month trapping review. In combination these data will provide a good benchmark for assessing the outcomes from this work.

**References**

Gibbons P, Lindenmayer DB, Barry SC, Tanton MT (2000) Hollow formation in eucalypts from temperate forests in southeastern Australia. Pacific Conservation Biology 6:218–228

Goldingay RL, Stevens JL (2009) Use of artificial tree hollows by Australian birds and bats. Wildlife Research 36:81–97

**Further details and a short video on the project are available at:**
**www.cumberlandlc.org.au/woody-habitat.html**

## Nest Box Design Structure and Attachment

**Narawan Williams, fauna ecologist specialising in nest boxes and microbats**
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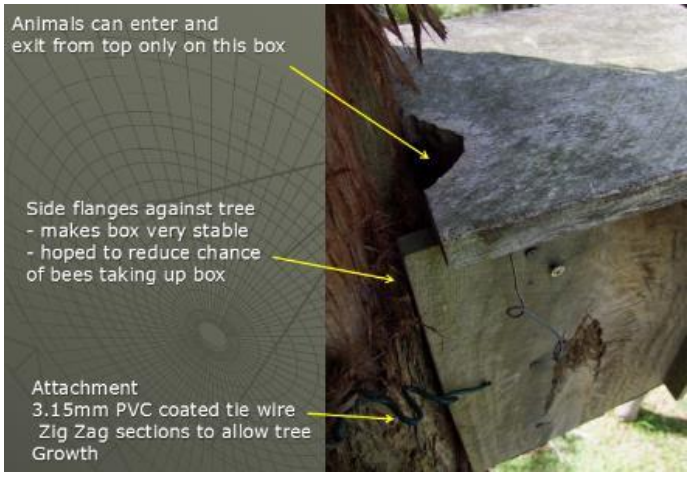
Nest boxes have a limited lifespan and often fail after only a couple of years. The two most common reasons for installed nest box failure are:

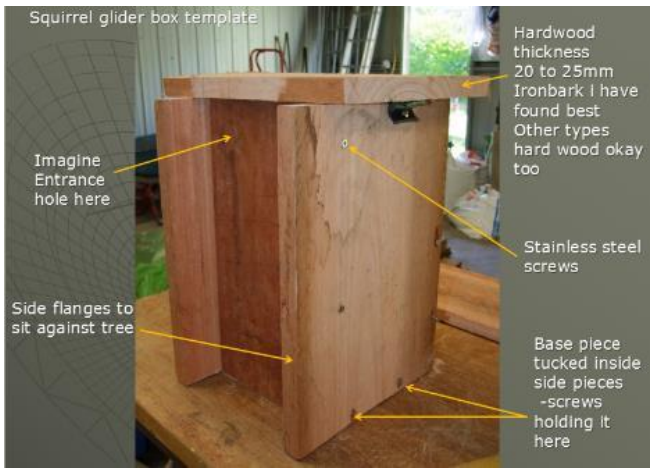
1. Lids falling off:
   - many designs have screws into end grain of ply
   - cut edges on the ply, the weakest part
   - decay around screws so becomes loose
   - Non-durable metal or rubber hinges
   - peeling and lifting ply
2. Attachment failure:
   - sap can eat through roofing, screws and metal strapping
   - attachment does not allow for tree growth
   - weakest point of attachment breaks when tree grows.

**Structure of Box: How to design boxes to increase lifespan**

Seven years ago I set out to try and design a box that will last at least 15 to 20 years without needing maintenance. I predict this box will last at least another seven years as it is still in good condition:

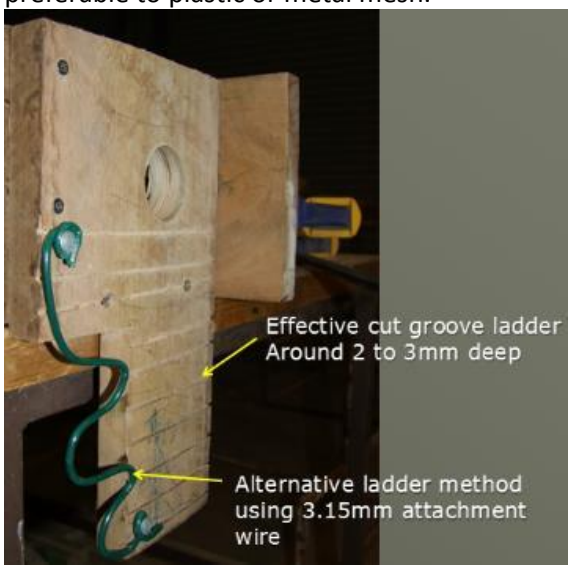





I recommend that lids should overhang all sides by at least 30mm if possible. Hinges and latches can be made out of large green rubber/PVC hose sliced in half or stainless steel hinges. Try to avoid putting any screws in

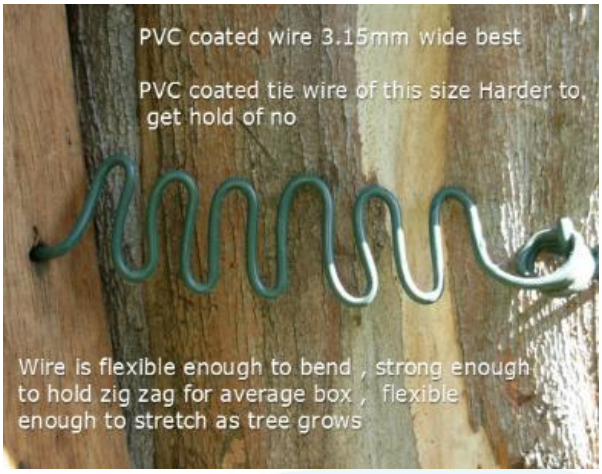
end grain of ply timber: across grain is much better. Cut angled grooves on and in boxes for fauna are preferable to plastic or metal mesh.





**Nest Box Attachment**

Use a 50 cm length of 3.15mm tie wire with knots on ends to fasten on sides of box to go around tree. Bend wire in zig zag to allow for trunk growth or use springs for heavy boxes making sure the spring will expand as tree grows. Cover wire with cut garden hose. As a second attachment and to assist instillation process use metal strapping on the back of the box and a galvanised nail to secure box to tree.

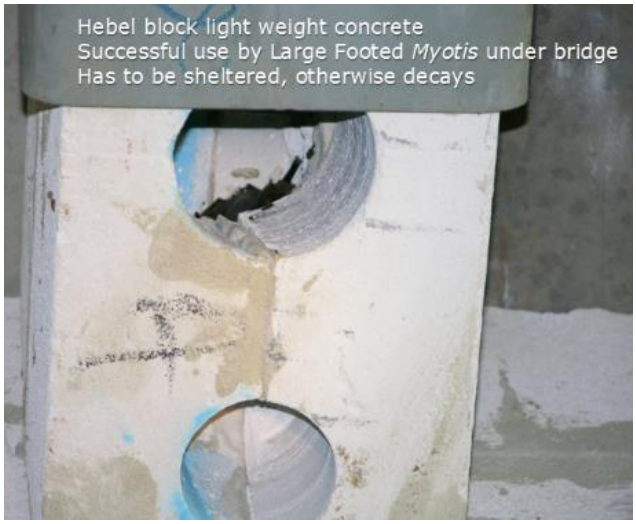




**Some examples of nest box designs:**

Note: one client asked for hessian to be placed behind box.


Knots on inside of box holding wire







**Summary of the most important features of design:**

- Good strong long lasting lid that protects rest of box.
- Lid overhangs all edges of box sides.
- Hinges protected under lid.
- Have a latch to help hold lid in place.
- Use double thickness of ply on lid.
- Screws stainless steel or galvanised.
- Screws going across grain NOT end grain of ply if possible.
- End grain of ply painted or metal capped.
- Attachment is durable - 3.15mm PVC coated tie wire.
- Attachment allows growth of tree – numerous zig zags in wire.
- Use hose around wire to protect tree – ordinary garden hose.


Don't be afraid to approach your nest box provider to discuss improving longevity of nest boxes for your sites.

## Eastern Pygmy-possums in Hornsby Shire

**Paul Burcher, Aquila Ecological Surveys** www.aquilaeco.com.au

Eastern Pygmy-possums are a small, mouse-sized marsupial, hb 70-110mm, tail 75-110mm; 15-43 (24)g. They are fawn/grey above and white below with large rounded ears and have a prehensile tail which is sometimes swollen at the base.

Eastern Pygmy-possums are found in South-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW they extend from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes.

Eastern Pygmy-possums feed largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias. They are not destructive to flowers and may assist in pollination. Nectar and pollen are eaten with their long, brush-tipped tongue. Soft fruits (eg. *Persoonia spp.*) are eaten when flowers are unavailable. They also feed on insects throughout the year; this food source may be more important in habitats where flowers are less abundant such as wet forests.

Eastern Pygmy-possums feeding on *Banksia ericifolia.*

Eastern Pygmy-possums shelter in tree hollows, rotten stumps, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation, rock crevices and burrows under the ground. Nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks. They appear to be mainly solitary, each individual using several nests, with males having non-exclusive home-ranges of about 0.68 hectares and females about 0.35 hectares. They frequently spend time in torpor, especially in winter, with body curled, ears folded and internal temperature close to the surroundings.

Eastern Pygmy-possum young can be born whenever food sources are available; however most births occur between late spring and early autumn, with 2 litters per season. There are usually four young to a litter which remain in pouch for ~30 days then left in the nest until weaned at ~65 days. At weaning they about ½ size of mother and are independent but may continue to associate with siblings. Their maximum longevity recorded in the wild is 4 years.

Eastern Pygmy-possums are listed as vulnerable on the NSW Threatened Species Conservation Act 1995, and also in South Australia. They are rated as “least concern” by the IUCN. They are vulnerable due to:

- Loss and fragmentation of habitat.
- Changed fire regimes that affect the abundance of flowering proteaceous and myrtaceous shrubs, particularly banksias.
- Declining shrub diversity in forests and woodlands due to overgrazing by stock and rabbits.
- Predation from cats, dogs and foxes. The eastern pygmy-possum was reported in 14% of a small sample of fox scats at Ku-ring-gai Chase National Park, 3% at Nadgee Nature Reserve.
- Altered predation regimes e.g. opening of understorey vegetation
- Loss of nest sites due to removal of firewood (state forest & private land).

**The Hornsby Eastern Pygmy-possum Nest Box Project**

Five boxes (4 constructed from salvaged timber & one made from PVC) were set at each of five sites in Autumn 2012. The dimensions of the boxes were 350mm x ~90mm with a 25mm hole drilled 50mm from top. They were attached to rough-barked tree/shrub and 1/3 filled with bark. An additional six sites (all salvaged timber boxes) were added in 2013. Four of the additional sites were discontinued in 2015 and the boxes moved to three new sites.

Eastern Pygmy-possums have been recorded at all the original sites (Cowan, Berowra Heights, Mt Kuring-gai, Berrilee, Maroota) and one of the 2013 additional sites (Glenorie). All 'successful' sites have significant stands of *Banksia ericifolia* and are within large areas of bushland. The breeding success rate at sites where Eastern Pygmy-possums have occupied boxes has ranged between 1% (Mt Kuring-gai) and 15% (Cowan). The overall breeding in nest box success rate for PVC boxes is 4%; for salvaged timber boxes 8.1%. It was found that PVC boxes were half as successful, and also not as well insulated or camouflaged, however the advantages of using PVC boxes are the ease of construction, they are lightweight, and there are no termite, ant or decay problems to contend with.

Above: a litter of Eastern Pygmy-possum young in a salvaged timber next box.

Below: a litter of Eastern Pygmy-possum young in a PVC next box.

**Key Learnings:**

- Nest boxes are being readily used by Eastern Pygmy-possums in good quality bushland with nectar sources.
- Some breeding success has been recorded.
- There are pros and cons to using PVC boxes.

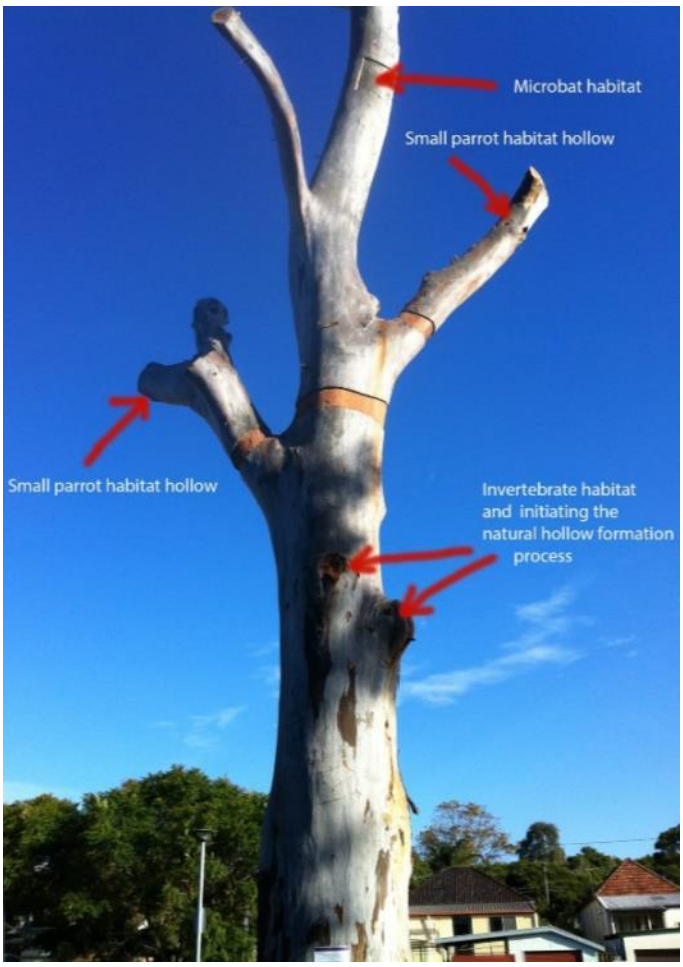
Thanks to Brad Law,
Alex Fraser and Mark Hood

## Habitat stags & logs – Providing habitat for native fauna in a contested urban environment

**- Sophie Golding – Urban Ecology Coordinator, City Of Sydney Council** sgolding@cityofsydney.nsw.gov.au **Gwilym Griffiths – Coordinator Tree Management, Marrickville Council** gwilym.griffiths@marrickville.nsw.gov.au **and Damon Bassett – Acting Team Leader – Biodiversity, Marrickville Council** damon.bassett@marrickville.nsw.gov.au

Urban pressures in the centre of Sydney has meant that there is limited open space, with little habitat retained for native animals. In order to augment habitat for local fauna residents, City of Sydney held a habitat stags and logs demonstration workshop in May 2014 with the Kenyon brothers from Victoria. Since then City of Sydney and Marrickville Councils have established habitat stags and logs at a number of sites. The collaborative partnership between the two inner urban Councils has been very helpful at trialling this new technique in Sydney.

Sites where stags and logs have been created and installed over the last twelve months include aquatic habitat logs for waterbirds and turtles, terrestrial habitat logs for Blue-tongue lizards and stags for microbats in Sydney Park, a habitat stag at Addison Road Centre in Marrickville with boxes and hollows cut in for microbats and small parrots, three live stags at Mahoney reserve, Marrickville with boxes and hollows cut in for microbats and small parrots, aquatic habitat logs on the foreshores of the Cooks River, and a habitat stag at McNeilly Park, Marrickville below:




This large *Eucalyptus saligna* had dropped several large branches onto an adjacent playground. Rather than being removed, it was lopped and turned into a habitat stag.

Ongoing management considerations for these projects differ between live and dead stags, including epicormic management; but all projects must include ongoing risk management and monitoring.

**Lessons learnt**

Some key principles learnt over the last year of implementation are:

- Competing objectives and risks need to be carefully managed.
- Nest boxes should be specifically designed to offer a range of habitat opportunities for target species. Know what target species are in the area.
- Provide other habitat opportunities on site where possible through nest box installation as part of comparison of what works.
- Works need to be planned and strategic but always be open to opportunities!
- Ensure ongoing monitoring is part of the plan and budget allocation.
- Work with skilled contractors and staff.
- Communicate objectives and manage expectations internally and externally.
- Collaborate with other Councils, share learnings and resources.
- Patience. It takes time for fauna to uptake, especially across the urban landscape.
- Community education is an important component, particularly regarding concerns over aesthetics. Signage can be important in highly visible public spaces, e.g.:

# Woodchips or Wildlife – repurposing trees for wildlife habitat

**- Robert Kerr, Tree Management Planner, Bankstown City Council**
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This case study is from Deepwater Regional Park, a site previously used as market gardens and with old quarries which are now waterbodies. There are Endangered Ecological Communities onsite - River-Flat Eucalypt Forest on Coastal Floodplains and Shale Gravel Transition Forest. Parts of the reserve had been planted with non-indigenous native species such as Tallowwood (*Eucalyptus microcorys*), Spotted Gums (*Corymbia maculata*), Flooded Gums (*Eucalyptus grandis*) and River She-oaks (*Casuarina cunninghamiana*). The site has a high wildlife density with lots of tree hollows being occupied. Wildlife surveys on-site and in adjacent areas found many species sugar gliders, possums, microbats, Grey-headed Flying Foxes, Owlet Nightjars, Swift Parrots and Musk and Little Lorikeets. The Park has old habitat trees, some of which posed public safety issues. There are many nest boxes in the Park as part of Council's extensive nest box program, although some are in disrepair and collapse.

**The scope of the 2014 Tree Works Program:**

- Clearing Stage 1 of all the planted Casuarinas
- Pruning and removal works in Stage 2 to remove tree hazards to park users
- Pruning and removal 10m either side of the shared pathway - including fire damaged trees.

The Program aims to deliver a net biodiversity gain to the site through replacement planting and habitat restoration. A number of terrestrial and aquatic habitat creation strategies have been used to date by repurposing trees and branches that had to be removed on safety grounds. There are plans to create hollows in standing trees in the next stage.

**Fish Crates**

Spotted Gum trunks were repurposed into three fish crates of roughly 1m3 in volume and craned into the waterbodies. Since the installation fish have been seen using the crates.

**Aquatic perching/landing sites**

A tree trunk was sectioned to create two cradle supports and an emergent section, were worked on to cut in cavities for aquatic fauna, then the three pieces were craned into the waterbody to create a landing area for ducks, turtles etc. An attempt to perch another trunk which was partially rotten proved difficult because it was too buoyant, so it was relocated for use as a terrestrial log.

**Terrestrial Habitat**

Hollow logs were also positioned in bushland areas away from high pedestrian areas to provide ground habitat. Sections of trunk where the timber was reasonably sound were cut to create hollows and cavities to provide habitat spaces, which will enlarge over time with fungal decay.

**Lessons Learnt at this stage of the Program:**

- Anchor aquatic logs to minimize movement (tides and floods).
- Beware of firewood collectors.
- Signage is needed to explain that the logs are used for habitat.
- Thoroughly research the site variables.
- Setting up a monitoring program is important.
- Take time to document the process, to share the information.
- Beware of budget carry over issues.

## Urban Habitat Creation: examples of pruning for habitat in inner Sydney - Michael Sullings, Sydney Arbor Tree Services

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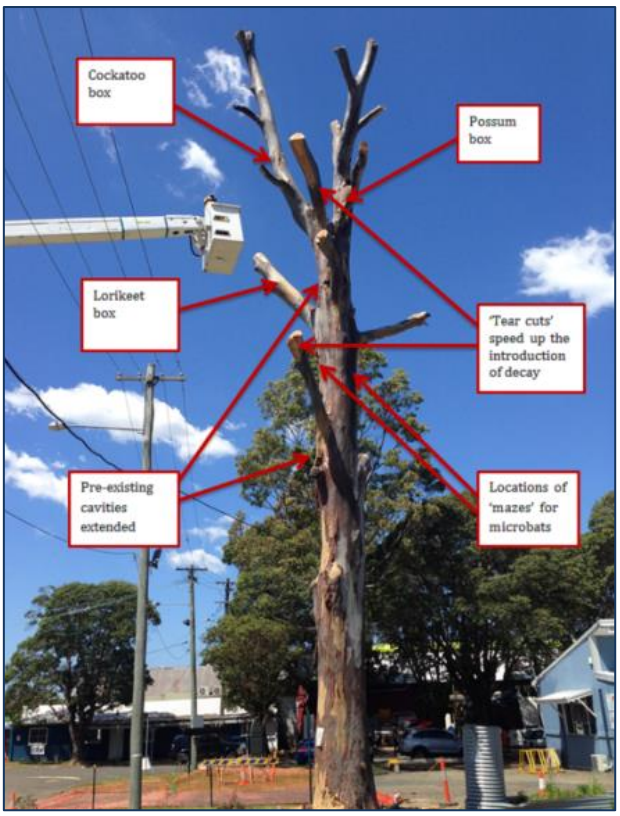
**Sydney Arbor Tree Services attended the May 2014 workshop run by Tree Tactics and City of Sydney, and since then has worked on a number of projects in inner Sydney: some are outlined below.**

After attending the workshop Sydney Arbor Tree Services decided that it would be a very rewarding area of work to move into, and started pitching our ideas to various councils and other organisations. The amount of interest surprised us, and before long we were engaged by Marrickville Council for our first trial. Despite some community protest due to the significance and prominence of that tree, we soon had calls to do more. We were involved in a joint project between Marrickville and the Addison Road Community Centre, to create a 'high-rise bird hotel' in a very significant, mature Eucalyptus which was becoming hazardous and was to be removed (see Figure 1). After consultation with Centre staff about which species they would like to attract, and with Council environmental officers regarding which species are known to exist locally, we got to work. We installed a large box for the use of White Cockatoos, a medium box for Brushtail Possums, a small box for Rainbow Lorikeets, and two 'bat mazes' for the use of microbats. We have already observed a pair of Rainbow Lorikeets using the small box! We think it's probably more likely that birds will find and use the possum box, unless the tree sprouts regrowth that provides some cover for the box, as mammals like. This tree – which is now signposted – will make for a great educational tool due to its location, and indeed, we have already started to get calls from private citizens interested in having their own habitat tree.



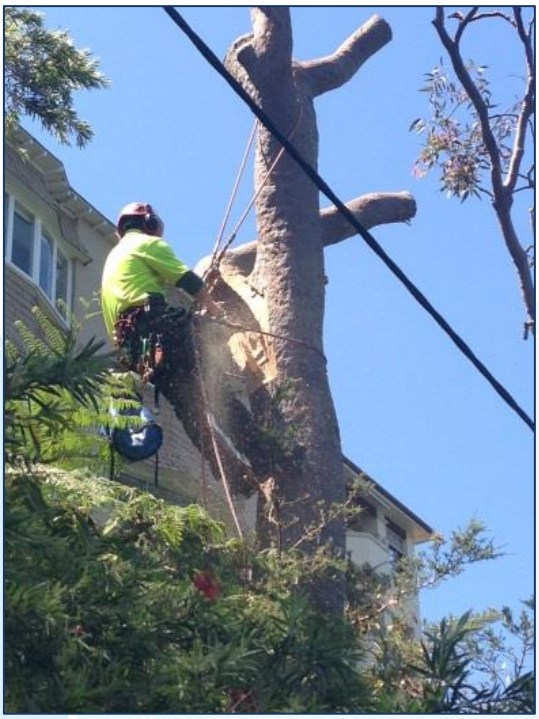

The habitat tree at Addison Road Community Centre, Marrickville, which was slated for removal after several large branch failures over a busy car park


Our first private job, working on a dead Silky Oak for some forward-thinking citizens.

Our first private job came from an environmentally-conscious couple in Beverly Park, who saw the value in the possibility of their children getting to see birds and possums raising families in their back yard. They had retained a dead Silky Oak pole for several years already, as the local birds used it for perching and socialising. We reduced the canopy and installed two small boxes intended for Rainbow Lorikeets and a large box for Laughing Kookaburras (see Figure 2). We also installed what we are calling 'in-stem planting positions' – essentially a small hole, with drainage, into which we planted several different cascading succulent species. The client suggested it, to make the pole look a little less lifeless, and it worked quite successfully. We are now considering other applications this may have – for example, planting a fig seedling, with the idea that it will eventually strangle the host, creating an ecologically valuable replacement tree in the process.

Speaking of figs as replacements, the tree shown to the right already had a well-established fig growing off its stem around 5m high, with roots reaching the ground. It was formatively pruned and retained as a replacement, and to provide cover for the two possum boxes that were cut into the lower stem, as mammals prefer a bit more concealment. Alternatively, birds prefer hollows with a clear flight path to and from, so a channel was cut into the fig canopy, and an owl box was installed in the upper stem, which still sticks out the top of the fig canopy (at this stage). This tree is located in the 'Backyard to Bush' section of Taronga Zoo, with the intention being to signpost it, and hold talks underneath it, to highlight the importance of tree hollows as habitat for native wildlife. The Zoo has actually been the most enthusiastic organisation we've contacted so far, with two trees completed already, and another two in the pipeline. They intend the trees not only as housing for the abundance of wild animals that make the Zoo their home, but also as exhibits and educational tools in their own right. Their media team is also providing online coverage and a pamphlet for their information centre. Enthusiastic clients and media exposure is needed to change public perceptions surrounding dead trees and logs. Our preoccupation with sanitation means the vast majority of timber from tree removals is turned to woodchip, removing not only habitat, but also food for microorganisms. Fewer microorganisms mean less food for larger invertebrates, which in turn means less food for vertebrate species. It also removes valuable nutrients that would otherwise be returned to the soil.

Installing a medium mammal box in the stem of the dead *Eucalypt*, which will be nicely sheltered by the canopy of the fig.



Installing a large bird box in an *Angophora* in Cremorne Reserve.

Another avenue for changing public attitudes lies with council tree and bushcare departments. Many of the tree management officers we have approached have responded very positively, as it offers a third option, in between retention and removal – allowing for the removal of hazards and the retention of some amenity. For example, North Sydney Council Bushcare pushed for the retention of three *Angophora* poles, even though they were located right outside an apartment block in Cremorne Point, see photo to the left. Some of the residents were unimpressed by the thought of having lifeless stags sticking up in their harbour views, but Council made a stand. Hopefully the residents' minds will change when the trees are revived by some colourful birdlife!

**More projects: Sydney Arbor Trees – Urban Habitat Creation**

# A history of Sydney Olympic Park's nest and roost box project – fighting the housing shortage

**Tina Hsu, Ecology Project Officer, Sydney Olympic Park Authority** tina.hsu@sopa.nsw.gov.au

**Background**

Approximately 15% of Australian terrestrial vertebrate fauna need hollows for shelter or breeding. Nationally, 114 bird species are hollow-dependent; 81 occur in NSW, 12 of which have been recorded at Sydney Olympic Park (the Park). These are the Crimson Rosella, Eastern Rosella, Little Corella, Long-billed Corella, Barn Owl, Southern Boobook and the Australian Owlet-Nightjar, and five species which breed on site - the Rainbow Lorikeet, Galah, Sulphur-crested Cockatoo, Laughing Kookaburra and Red-rumped Parrot.

Nationally, 83 mammalian species are hollow-dependent; 46 occur in NSW. The Park supports 12 mammals that use hollows - the Common Ringtail Possum and Common Brushtail Possum (although ringtail possums usually roost in dreys), and ten species of microbats. Three microbat species are listed as threatened under the NSW *Threatened Species Conservation Act 1995*, and the group is considered a conservation priority by Sydney Olympic Park Authority (the Authority).

The majority of hollow-dependent animals live in Newington Nature Reserve forest (the Reserve), which contains a 13ha remnant of Sydney Turpentine Ironbark Forest, a critically endangered ecological community. The forest is located in Newington Armory, formerly the Royal Australian Navy Armament Depot. Military use excluded public access and exploitation of the forest for more than 100 years, allowing trees to grow and develop a multitude of hollows.

Since Sydney Olympic Park was constructed and planted for the 2000 Olympic and Paralympic Games, trees in the Park are too young to have hollows. The need for supplementary habitat was recognised early, partly due to observations of possums living in rubbish bins. The first nest and roost box project ran for three years from 2003 to 2006; 53 boxes were installed – 20 for birds (marine ply), 30 for bats (hardwood) and 3 for possums (marine ply). Only the possum boxes were successful. Indian mynas, starlings and feral honeybees occupied boxes. By 2009, some boxes have gone missing and most were in disrepair. Less than one-third of boxes - those made from hardwood - were in reasonable condition for reuse.

The first project, though unsuccessful, taught us the importance of box material, placement and design. Marine ply is not durable compared to hardwood. Waterproofing is required if we want to increase box longevity. The boxes were mounted to 3-4m due to safety concerns and for ease of inspection; a variety of heights should be investigated. Attachment methods used e.g. nailing mounting strips to the sides of trees and looping wire over small branches, were inadequate; stable attachments that go around the tree trunk and allow tree growth are essential. Branches and growing shrubs obscured some box entrances which probably contributed to lack of success. Anti-myna baffles did not deter mynas on all occasions but this may be due to the positioning of a perch at the entrance, allowing mynas to land there. A combination of anti-myna baffle and bird 'ladders' allowing parrots to climb to the entrance should be trialled.

**Current project - overview**

Armed with past lessons and increasing knowledge, along with consultation with an experienced wildlife surveyor licenced to work at heights, the second/current nest and roost box project commenced in October 2010. 10 new possum boxes, 5 hollow logs for birds, 5 bat boxes from the first project, modified, and 5 new bat boxes were installed. All boxes were made of hardwood. To provide additional habitat for the threatened Large Bent-wing Bat and the Southern Myotis, three large boxes customised to suit the species were installed

in June 2011. In May 2012, after two seasons of studying hollow competition in the Reserve which found that the Red-rumped Parrot is being outcompeted by larger parrots and will continue to decline without management intervention, 8 customised nest boxes were installed. In April 2013, 3 bat boxes unsuccessful in attracting bats since October 2010 were modified and/or relocated. Similarly, in April 2014, 5 natural logs for birds unsuccessful since October 2010 were relocated and remounted – 3 as homes for the Red-rumped Parrot and 2 for bats. A new bat box known to be successful in accommodating multiple species (Inverse U - see Tanya Leary's article) was added in April 2014.

Monitoring began in October 2011 and is conducted on a half-yearly basis, in April and October to avoid disturbing nest and roost box users during the peak breeding season. There have been 8 inspections to date (April 2015).

Nest box inspection by contract ecologist licenced to work at heights.

**Results to date (April 2015)**

Possum boxes (10) installed in October 2010 – one simple design of a rectangular box of approx. 45x30x35cm with an entrance of 12x13cm. Eight of the 10 boxes have been in use consistently since the first 1 to 1.5 years after installation; it's likely that some boxes were taken up in the year between installation and the first inspection. The only box to not have shown any signs of usage by possums is located in a young eucalypt woodland with no understorey. The box was placed there as possums were seen moving through the area and one was seen sleeping in a bin. It appears that there are better habitats elsewhere. Six occupied boxes are in close proximity to each other (10-50m), suggesting it is ok to have possum boxes in close proximity to each other.

Natural logs for birds (5) installed in October 2010 – not successful, and 3 were used by rodents. Two logs were modified and installed vertically as bat roosting logs in April 2014. One Gould's Wattled Bat was found in April 2015.

Modified bat boxes (5) installed in October 2010 – approx. 50x20x10cm not including landing platform. All showed signs of bat usage such as droppings or actual bats (Gould's Wattled Bat or Lesser Long-eared Bat). Average time from first check in October 2011 to first use was 2 years (range from 1.5 to 3 years). Boxes were mounted to different aspects (N, NE, NW, S and W) with no difference in results. Modifications include the addition of entries through a short length of hollowed branch (spout) and small slits at the side of the box; splitting one chamber into several smaller chambers to suit bats of different sizes and in different numbers; a cover at the cavity base to help maintain a stable microclimate; the cover can be opened to allow for inspection without disturbing bats which usually cluster at the top of the cavity.

New bat boxes (5) installed in October 2010 – large (approx 33x35x30cm), open base design with many chambers. Only one was successful (Gould's Wattled Bat present in each April from 2013 to 2015, aspect South). Three boxes were taken down and modified to emulate the modified boxes i.e. adding attractive entries through a spout and at the box's side, partially covering the bottom of the box, and drilling a hole between two chambers at the far end from the entrance so bats can move between chambers. Two boxes were relocated close to or on trees with successful bat boxes present and one returned to its original location. All three have been taken up by bats after 2 years. Bat droppings (relocated, aspect S), 12 Gould's Wattled Bat (modified, aspect NE) and 1 Lesser Long-eared Bat (relocated, aspect N) were recorded respectively.

A hardwood bat box featuring entries through a hollowed branch/spout and a side slit, a removable cover at cavity base to maintain stable microclimate and facilitate inspection, a grooved landing platform, and multiple chambers to suit different species and/or different numbers of bats.

Bat boxes (3) installed in June 2011 – placed in culverts over a pond in a large freshwater wetland to attract species that prefer to roost in caves, tunnels and under bridges. Droppings were seen in 2 boxes, 1.5 and 2.5 years after installation, and many times since. Finally after 4 years, six Southern Myotis were sighted in a box located in the culvert about midway over the pond.

The culvert where a bat box has been installed.

Bat 'mansion' (1) installed in April 2014 – very large and heavy (~35kg) structure, comprised of a horizontal section with two wings, each containing an internal box, allowing bats to move to different sections and to different chambers based on their thermal needs. It was installed in a tree next to a tree with a successful bat box. Aspect NE. Only took 1 year to be used by a Gould's Wattled Bat and a Lesser Long-eared Bat at the same time.

A bat 'mansion' for multiple species (left) housed a Gould's Wattled Bat and a Lesser Long-eared Bat in different sections of the box at the April 2015 inspection. The bat box at right has been used by the same two microbat species.

**Red-rumped Parrot project**

The Park has a regionally significant population of the Red-rumped Parrot. The species is at the eastern most end of their range, and is a priority for conservation at the Park. Studies on hollow usage found intense competition for hollows in the Reserve and constant displacement of the parrot by Rainbow Lorikeets. Despite the large number of unused hollows available in the Reserve, two pairs of Red-rumped Parrots were found nesting in Homebush Bay, in the posts of a disused wharf surrounded by open water, at the end of an industrial/business district. Their use of this suboptimal habitat is indicative of their versatility but also the intense competition for hollows, which is probably contributing to their decline in the Park.

In May 2012, 8 boxes were custom made for the species, 2 from PVC, and 6 from hardwood. Two were installed near the Reserve, and 6 in Archery Park, near the nesting site at the old wharf and unmown turf where the birds are known to feed. The boxes have: a landing platform with a ladder for climbing, internal ladder for young to climb out, a small entrance (<60mm) to exclude non-target parrots, anti-myna baffle, peat moss for nesting, and a side hatch or removable lid for inspection. They were mounted to 5m or above and face NE or E. Internal dimension is approx. 10x20cm. Two of the hardwood boxes were 'vertical' (height 40-45cm) and 4 horizontal (length 40-45cm); 2 of the latter were mounted at 45 degrees. Only nest boxes at Archery Park have been successful. Eggs and fledglings were found in 3 boxes – PVC, hardwood horizontal and hardwood vertical – over three breeding seasons (2012-13, 2013-14 and 2014-15).

Three natural bird logs were mounted in Archery Park in April 2014 to investigate whether the parrots would prefer natural-looking hollows. No usage by parrots as yet. However bat droppings were found in 2 of the 3 logs during the April 2015 inspection.

Nest boxes and logs for Red-rumped Parrots (9) and roost logs for microbats (2) at Archery Park.

**Summary**

- For microbats, aspect is not critical but a variety is necessary to cater to different seasonal needs
- Boxes should be tailored to fauna groups or species, e.g. entrance size, climbing platform etc
- Go where the animals are
- Be adaptive – reuse, modify, or relocate
- Good, durable design will save time and money
- Patience – expect 2+ years before use
- Monitoring on a half-yearly basis is adequate, unless you need information on movement and recruitment rate.

## Human Assisted Habitat Creation – how to do it well

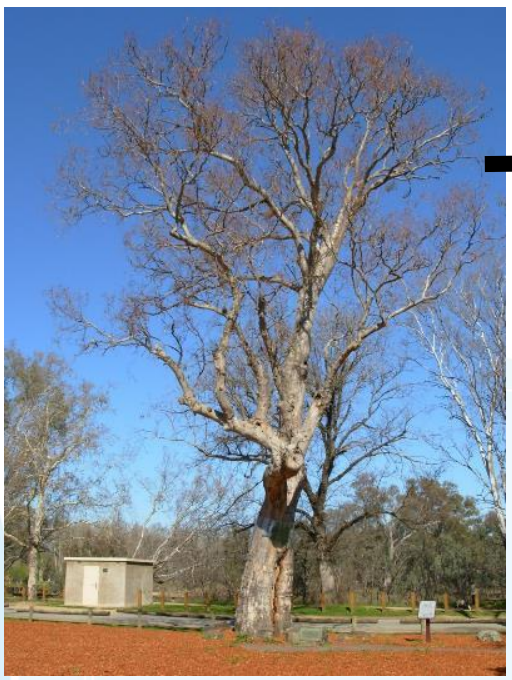
**Pat Kenyon, TreeTactics Victoria** www.treetactics.com.au

**Ben Kenyon, Homewood Consulting** www.homewood.com.au

**Some points to consider when artificially creating habitat:**

- Where is it appropriate?
- When is it appropriate?
- Re-vegetation in conjunction with habitat creation
- The entire ecosystem
- Entrance size is vital
- Length of entrance tunnel
- Aspect - openings faced away from severe weather
- Temperature - warm and ventilated
- Drainage - waste drains out of nest
- Landing platforms - required by some hollow users
- Escape ladder for young
- How many habitat sites in each tree?
- How close can each site be situated?
- Discouraging feral and predator animals.
- Light exclusion for owls and some bats.
- Height of lip in the hollow
- Complimentary planting to provide, food, cover and aesthetic screening.
- Retain any natural habitat if possible

**An example of a successful park tree conservation project:**



Habitat tree shows excellent canopy recovery after collar installed to protect from possum over-browsing (note trees in background still suffering decline), drip-zone is mulched, local shrub species under-planted.

**Habitat Trees - Hollow Dimensions (Victoria):**

| Hollow Type | Orientation * | Height (cm) | Width (cm) | Depth (cm) | Entrance Hole (cm) | Above Ground (m) | Wildlife Species |
|---|---|---|---|---|---|---|---|
| **Pardalotes** | - | 10 | 13 | 10 | 3 | 1+ | Pardalotes |
| Grey Shrike-thrush | - | 25 | 18 | 18 | 9x9 | 2+ | Grey Shrike-thrush |
| **Bats** | V | 30 | 15 | 15 | 1.2-1.5 | 4+ | OR Bat shields |
| **Small Mammals & Birds** | V | 30 | 15 | 15 | 3 | 1.5-5 | Pygmy Possums/Feathertail Glider |
| | V/H | 50 | 15 | 15 | 4.5/6/8 | 4+ | Small Parrots/Treecreeper/ Owlet-nightjars |
| **Medium Mammals & Birds** | V/H | 55 | 20 | 20 | 7 | 4+ | Medium Parrots |
| | V/H | 45 | 20 | 20 | 8/4/4.5 | 4+ | Small Possum/Sugar/Squirrel Glider |
| **Brushtail Possum** | V/H | 45 | 30 | 25 | 10 | 4+ | Brushtail Possum |
| Small Ducks | H | 45 | 35 | 35 | 10/15 | 2+ | Small Ducks |
| Kookaburra | H | 30 | 30 | 50 | 12x18 | 4+ | Kookaburra |
| Barn Owl | H | 40 | 40 | 90 | 25x15 | 6+ | Barn Owl |
| Cockatoos | V | 100 | 40 | 30 | 18 | 10+ | Cockatoos |

***Additional information***

Bees: will potentially invade hollows of this size. Other invasive species (e.g. Indian Mynas & Starlings) may also invade any mid size boxes.

- The *Hollow Types* in bold cover many of the more common species and are recommended as good hollows to start on.
- Created hollows in habitat trees require inspection and maintenance, as does any artificial nesting/roosting site.

* H = horizontal & V = vertical.

*N.B. The above species list and associated measurements are an initial guide to the dimensions, required by a range of hollow dependent wildlife found across southern and eastern Australia.*



**Habitat Trees - Hollow Dimensions (City of Sydney):**

| | Orientation | Height (cm) | Width (cm) | Depth (cm) | Entrance Hole (cm) | Above ground (m) | Notes |
|---|---|---|---|---|---|---|---|
| Powerful Owl | N/A | 80 back; 70 front (to provide runoff) | 55 | 55 | 20 | 15 to 20 | Add ladder and blocks of wood to allow easy egress |
| Southern Boobook Owl | N/A | 45 | 20 - 22 | 23 - 25 | 10 | 15 to 20 | |
| Spotted Pardalote | N - NE | 12 | 12 | 40 | 3 | 5 | 3cm entry on a 10cm long tunnel-shaped entrance. |
| Gould's Wattled Bat | N | | | | | 10 | Clear flight path required |
| Ringtail possum | N/A | 45 | 20 | 20 | 7 | 3 to 5 | |

**Procedures for making artificial hollows in habitat stumps and trees:**

- Identify tree that can be retained as a habitat stump rather than removed.
- Remove canopy back to a level that is acceptable to reduce target area or risk of limb failure.
- Retain any existing hollows if possible.
- Protect hollow forming stubs.
- Choose sites for habitat that will not create hazards.
- Develop strategies to create habitat and minimize hazards.
- Constrict or ring bark branches.
- Shear branches to create habitat ends.

**Example of a artificial hollow being created in a tree:**

**A high level of skill and safety is required when using chainsaws for habitat creation:**

- Boring with a chainsaw is very dangerous.
- Extra care and skill required.
- Habitat boring only undertaken by trained skilled operators.


Branch collar girdled in a living tree.

Dead trees planted as roost and habitat in wetlands.

# Field Testing of Nest Box Preferences

**Ross Goldingay - School of Environment, Science & Engineering, Southern Cross University, Lismore NSW** ross.goldingay@scu.edu.au

**Introduction:**

This presentation was aimed at providing a very brief overview of research I have been conducting for over 10 years to determine whether the management application of installing nest boxes and bat boxes can be improved through understanding design preferences by species.

A recently published study (Goldingay et al. 2015) tested different nest box designs in two different landscapes (one rural and one urban).

**Key findings:**

Some species did favour specific designs, which was mainly determined by entrance diameter.

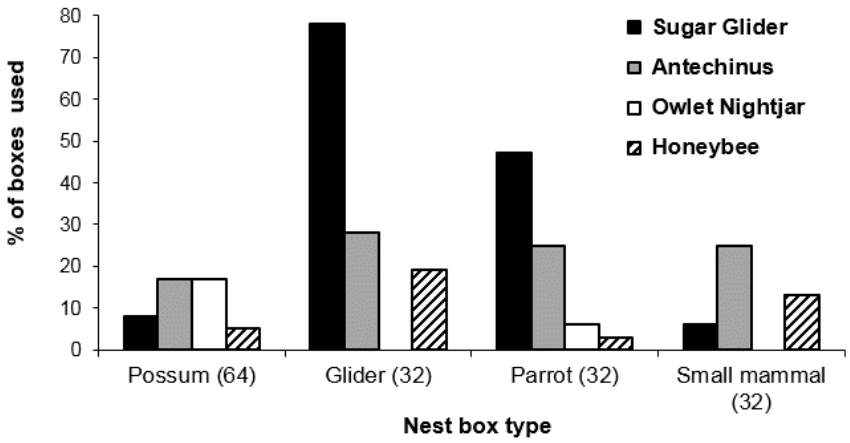
A rear-entry glider box (only included at Brunswick Heads) was highly favoured by sugar gliders. They did use other box types but this relates to their preference for more than a single nest box in a patch.

Honeybees used about 10% of boxes but they usually departed after 1-2 yrs. This is an important finding because attempts to exclude bees can be labour-intensive and any attachments such as carpet do not prevent use. I recommend ignoring bees. Many boxes were not used by other species so bees are not creating a shortage where large numbers (>20) are installed.

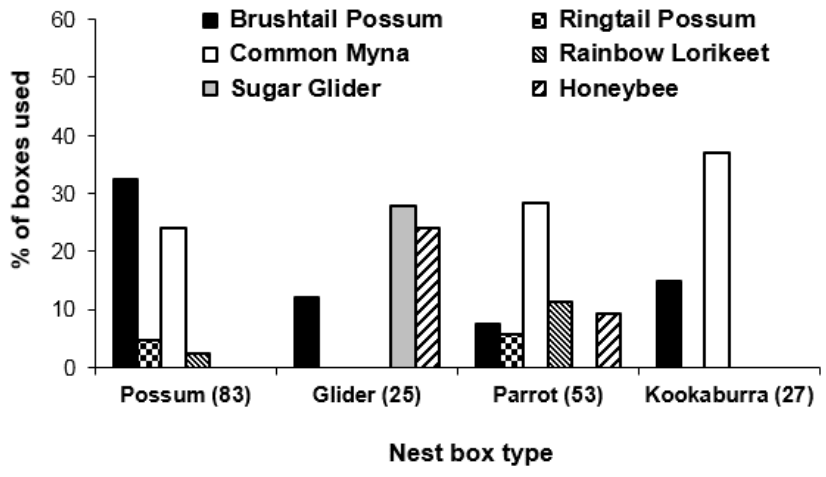
The nest box entrance baffle did not prevent use by mynas. Mynas can be excluded by entrance size and using rear-entry nest boxes if mammals are a priority.

This study also demonstrated that squirrel gliders occupied nest boxes permanently on 2 properties at Pomona, Qld, over a 10 year period with minimal maintenance of the boxes.

**Results from Brunswick Heads (Rural):**




**Results from Bankstown (Urban):**



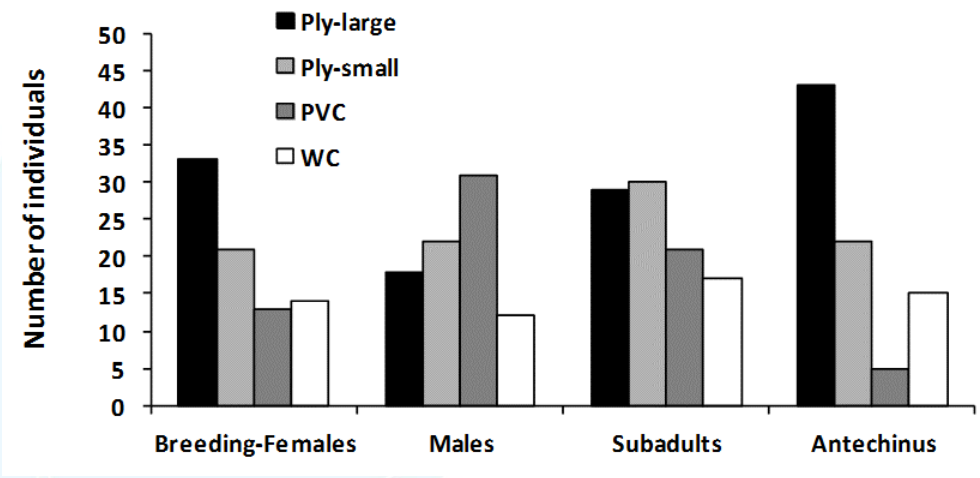
**Preferences by the eastern pygmy-possum**

Many studies have documented that pygmy-possums will shelter in a wide variety of sites including buildings, birds nests, holes in the ground and under leaves of grass trees. We tested a variety of nest box designs (see photos) in Royal National Park (Rueegger et al. 2012).

All boxes were used (which relates to entrance size; see graph) but breeding females showed a preference for a large plywood nest box. Males and subadults showed no preferences. What isn't shown in the graph is that the breeding females moved into the boxes to breed and occupied boxes less commonly when not breeding. This suggests a requirement for a proper cavity when breeding. It suggests the perception from observations of pygmy-possums using almost anything is very misleading and tree hollows (or nest boxes) are required for population persistence.


Antechinuses also showed a strong preference for breeding in the large plywood boxes.

**Results from Royal National Park:**




NB: WC = wood cement

**Trialling a large rear-entry nest box:**

This project has been attempting to get yellow-bellied gliders into nest boxes. Large rear-entry boxes were installed within known yellow-bellied glider territories in western Victoria (see photos) and at Jervis Bay.

I've had success in getting ringtail possums, brushtail possums and sugar gliders to use these boxes but not yellow-bellied gliders. This may reflect too many tree hollows within very large territories (50-100 ha) to get their interest. Nonetheless, it indicates how this design is very targeted to arboreal mammals.

**Future work:**

With Niels Rueegger, we are now investigating different bat box designs to see whether designs can become more effective than what many are at present.

**References**

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Goldingay, R.L., Grimson, M.J. & Smith, G.C. (2007). Do feathertail gliders show a preference for nest box design? *Wildlife Research* 34, 484-490.

Goldingay, R.L., Rueegger, N.N., Grimson, M.J. & Taylor, B. D. (2015). Specific nest box designs can improve habitat restoration for cavity-dependent arboreal mammals. *Restoration Ecology* (in press).

Goldingay, R.L. & Stevens, J.L. (2009). Use of artificial tree hollows by Australian birds and bats. *Wildlife Research* 36, 81-97.

Rueegger, N.N., Goldingay, R.L.. & Brooks, L.O. (2012). Does nest box design influence use by the eastern pygmy-possum? *Australian Journal of Zoology* 60, 372-380.

## Case study: Relocated Hollows and Nestboxes in Wyong

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Wyong Shire Council encourages developers to avoid and minimise the loss of tree hollows. The standard condition of consent requires natural hollows or nestboxes be installed at a 1:1 ratio and monitored and maintained for three years. After seven years, only 27 of the 98 nestboxes installed in Wadalba Wildlife Corridor are still functional due to poor quality materials and construction such that lids fall off, boxes fall apart or fall off trees.

In 2011 Travers Bushfire and Ecology (TBE) and Council relocated a Powerful Owl nesting hollow at Wadalba. A 3 metre section of hollow trunk was cut and lowered, preserved with linseed oil, cut to fit into fork of recipient tree, base capped to hold in termite mud, installed using crane (Photo 1) and strapped to recipient tree (Photo 2). Challenges included shortage of large recipient trees that could be accessed by crane, as such final hollow height (18 m Photo 3) not as high as original (27 m) and recipient tree only 33 metres from bushland edge. Two large forest owl nestboxes also installed (Photo 4). Annual monitoring conducted during owl breeding season using remote surveillance cameras, visual inspection and stagwatching. In 2012 Sulfur-crested Cockatoos were nesting in the hollow. In 2014 a male Barn Owl was using the hollow as a satellite roost and a pair of Sulfur-crested Cockatoos were regularly preparing the hollow for nesting. No owl activity was recorded at the nestboxes, Sulfur-crested Cockatoos nesting in one. Hollow had higher usage by a greater diversity of hollow dependent fauna (nine species) compared to nestboxes (six species) over the four months of monitoring (Photos 5 and 6).

In 2015, TBE assisting Council to relocate a 20+m section of trunk with large hollows suitable for Powerful Owls.

**Photo 1** Installation of hollow section by crane and tree climber.

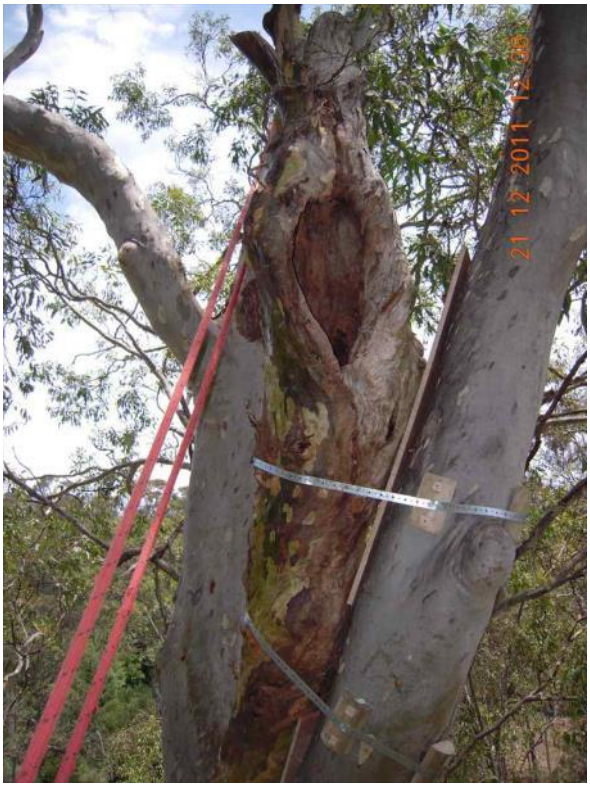


**Photo 2** Hollow section in fork of recipient tree.

Photo 3 Hollow section in fork of recipient tree .

**Photo 4** Installation of Large Forest Owl Nestbox by tree climber.


Photos 5 and 6 Use of hollow by Southern Boobook and Barn Owl in 2014.

## Case study: Squirrel Glider Project in Crowther

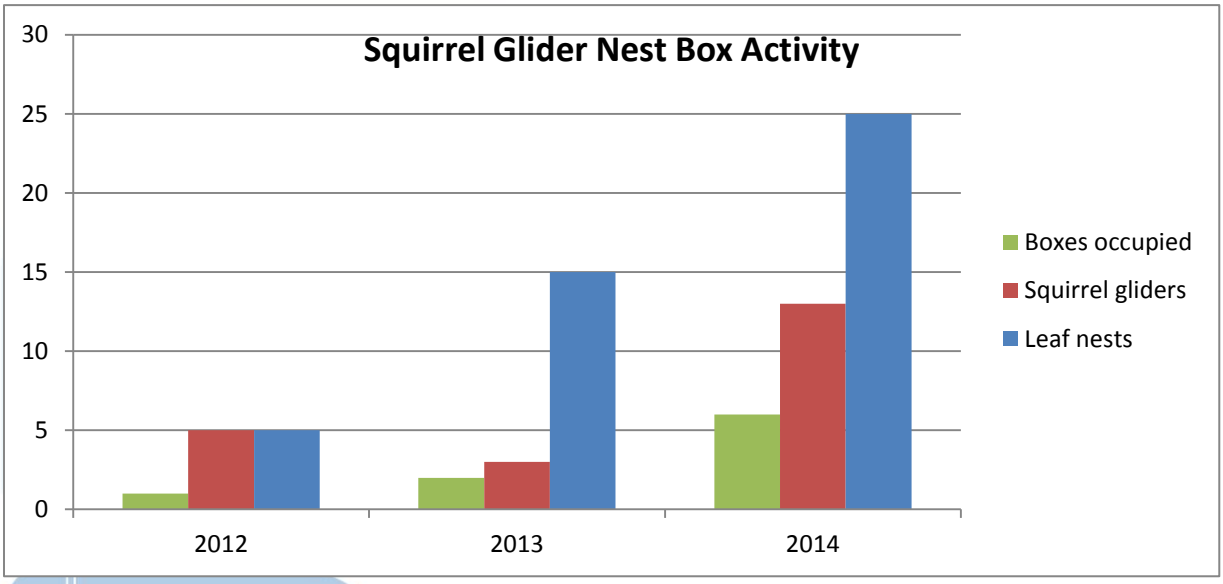
**Vanessa Cain, Mid Lachlan Landcare**
midlachlanlandcare@gmail.com

The Squirrel Glider Project was initiated by the Lachlan Catchment Management Authority in 2011 as part of the program "Communities Protecting Threatened Species" which aimed to foster public awareness of threatened species and address known threats by implementing on-ground works aimed at improving habitat quality such as installation of nest boxes, planting of trees and shrubs, barbed wire removal and trapping and baiting of cats and foxes. The program engaged the community in an effort to encourage project ownership beyond the LCMA's involvement.

The project location at Crowther was selected based on NSW Wildlife Atlas records but also landholder accounts of Squirrel Gliders entangled in barbed-wire and WIRES rescues performed in the area. Spotlighting and monitoring of the nest boxes began in autumn 2012 with five squirrel gliders initially detected using a single nest box. A total of 99 nest boxes are now installed on 10 properties with monitoring conducted bi-annually during autumn and spring.

Family of Squirrel Gliders using an artificial nest box.

Occupancy rates are increasing with singles, couples and family groups found using both front and rear entry boxes positioned in a number of different eucalypt species within remnant box gum woodland and ironbark vegetation communities. Surveys conducted during May 2014 found a total of 31 nest boxes were being used by Squirrel Gliders with 13 gliders detected using six nest boxes, and 25 active leaf nests unoccupied at the time of surveying.



Remote cameras trained on a number of nest boxes have detected Squirrel Gliders (with juveniles), Feathertail Gliders, Yellow-footed Antechinus, and Common Ringtail and Common Brushtail Possums.

Single Squirrel Glider using a nest box .

an unoccupied but active leaf nest.


Feathertail Glider picked up by the remote camera.


Squirrel Glider picked up by the remote camera.

nest box monitoring

## Case study: Squirrel Glider Conservation Project

**Vanessa Cain, Mid Lachlan Landcare** midlachlanlandcare@gmail.com

John Holland Rail Pty Ltd (JHR P/L) under contract from Transport for New South Wales Country Rail Contracts is engaging various conservation specialists and community groups across the Country Regional Network (CRN). Throughout the CRN there are number significant environmental areas, one of which includes the non-operational rail easement from Blayney to Demondrille that contain the important remnants of a Box Gum Woodland Endangered Ecological Community (EEC).

A Squirrel Glider detected by spotlighting.

Box Gum Woodland EEC's within the rail easement and adjacent lands have been heavily degraded over the years due to rail and road infrastructure, as well as agricultural grazing and cropping. Where remnant trees still exist in the region, the grassy and shrub understory has been extensively cleared. The significant reduction in extent and condition of Box Gum Woodland has impacted on many woodland dependent fauna. The Squirrel Glider (listed in NSW as Vulnerable) has been previously recorded in the area and is highly reliant upon woodland remnants for denning and nesting in hollows, but also for foraging on arboreal arthropods, nectar, pollen and manna provided by eucalypts but also from a variety of midstorey *Acacia* species.

In order for JHR P/L to meet environmental legislative expectations, it is anticipated that the land manager make reasonable efforts to conserve biodiversity values across the network. Therefore, this project aims to improve remnant patches of Box Gum Woodland and provide additional roosting and foraging resources for the local Squirrel Glider population.

Prior to the commencement of the project, conservation priority mapping identified high, medium and low conservation value areas along the rail corridor between Cowra and Young. Spotlighting was undertaken within a subset of these areas and detected two Squirrel Gliders in a remnant patch of woodland dominated by Yellow Box (*Eucalyptus melliodora*), Blakely's Red Gum (*E. blakelyi*) and Grey Box (*E. microcarpa*).

Within the project site (circled yellow), Squirrel Gliders are confined to a narrow stretch of rail corridor that is intersected by a thin strip of riparian habitat. Connectivity to larger patches of nearby remnant vegetation is low with dispersal opportunities limited to north and south-east along the creek.

The project site is dominated by Yellow Box and Blakely's Red Gum.

Local seed collection

Mid Lachlan Landcare has partnered with JHR P/L in order to deliver on-ground works by identifying sites being used by Squirrel Gliders within the rail corridor, developing a monitoring program for uptake and habitation of nest boxes, and instating 2500 shrubs. Various other community groups and local businesses have been engaged to undertake activities including nest box construction, seed collection, preparation, and propagation, and nest box installation.

Following the detection of Squirrel Gliders, sixty nest boxes were constructed and installed within the rail easement. Seed collection and propagation is complete with planting scheduled to take place in June 2015. Monitoring of nest boxes is scheduled to begin during spring 2015.

## Displays by Non for Profit Organisations

www.sydneywildlife.org.au

Rescue Hotline: 02 9413 4300

Sydney Metropolitan Wildlife Services Inc (Sydney Wildlife) was formed in May 1997, by a large group of experienced wildlife carers, to meet the specific needs of urban wildlife in the Sydney metro area.

www.wires.org.au

Wildlife Rescue 1300 094 737

WIRES (NSW Wildlife Information, Rescue and Education Service Inc.) has been rescuing and caring for native animals since 1985. Our mission is to actively rehabilitate and preserve Australian wildlife and inspire others to do the same.

www.cumberlandlc.org.au

The Cumberland Land Conservancy (CLC) is a volunteer operated not-for-profit organisation established to protect and restore the natural environment of western Sydney. Our core purpose is to acquire and conserve land locally for wildlife conservation.

## New Educational Tool Available

www.questagame.com

QuestaGame takes you outdoors - to your backyard, your neighbourhood, a park, anywhere at all - and sets you out on quests in the natural environment. Submit sightings, earn gold, conquer territory, compete with other players and more. Available on the App Store and Google Play. It's free!

## Greater Sydney Local Land Service Offices

**Website:** www.greatersydney.lls.nsw.gov.au

**Email:** admin.greatersydney@lls.nsw.gov.au

### Penrith

Level 4, 2-6 Station Street, Penrith NSW 2750
PO Box 4515, Westfield Penrith 2750
(02) 4725 3050

### Parramatta

Ground Floor, 10 Valentine Avenue, Parramatta, 2124
PO Box W274, Parramatta Westfield, NSW 2150
(02) 9842 8700

### Camden

61 John Street, Camden 2570
PO Box 141, Camden NSW 2570
(02) 4655 9165

### Wyong

3/34-36 Pacific Highway, Wyong 2259
PO Box 600, Wyong NSW 2259
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