ABSTRACT

The intense wildfire in 2019 caused a severe population decline of gliders and Glossy Black Cockatoo due to burning death, along with loss of nesting hollows and food resources. Assisted recovery of these populations in Torrington State Conservation Area, Curry's Gap State Conservation Area and Washpool National Park (Spirabo) is recommended.

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HABITAT SURVEY

for:

Bushfire Recovery for Wildlife and Habitat Community Grants Program

Australian Government
Department of Industry, Science, Energy and Resources

GLENRAC
Glen Innes Natural Resources Advisory Committee

BRCG000171 - Homes and Habitat for Gliders and Glossy Black Cockatoos – Northern NSW

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and

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Contents

Introduction: Homes and Habitat for Gliders and Glossy Black Cockatoos – Northern NSW

The Bushfire Recovery for Wildlife and Habitat Community Grant Program (BRCG) is part of the Federal Government's investment in the recovery of native flora and fauna affected by the 2019-20 bushfires.

The 2019 fires on the Northern Tablelands followed several years of severe drought. The combined effects of these disturbances had major impacts on the habitat of Glossy Black Cockatoos and gliders (Sugar Glider, Squirrel Glider, Feathertail Glider, Yellow-bellied Glider and Greater Glider) through the loss of hollows and food resources. The project BRCG000171 aims to assist in recovery of these species by the placement of artificial hollows in three reserves (Torrington State Conservation Area, Curry's Gap State Conservation Area and Washpool National Park; Figure 1, p2), burnt by high intensity wildfires, and revegetation planting of food trees on private property and, possibly, national park reserves near these locations.

Figure 1 shows the extensive area burnt on the Northern Tablelands in the 2019-20 wildfires. Three locations were nominated by the GLENRAC Steering Committee, supervising project BRCG000171, as potential recovery sites for Glossy Black Cockatoos and gliders, Figure1, p2):

1. Torrington State Conservation Area (SCA)
2. Curry's Gap State Conservation Area (SCA) near Tenterfield
3. Washpool National Park (Spirabo)

These three areas were surveyed to determine the intensity of the wildfire that occurred there in 2019, the impact of the fires on extant hollows and presence of food resources for the Cockatoo (Allocasuarina sp.) and the gliders. Potential artificial nest box placement nodes were identified at the same time. All the species included in the project are dependent on tree hollows as part of their ecology as either nest sites and/or shelter.

This report assesses the different types of artificial hollow designs available for potential use in the project for Glossy Black Cockatoos and gliders and makes recommendations on the most appropriate type for the burnt areas selected for assisted recovery of habitat for these animals.

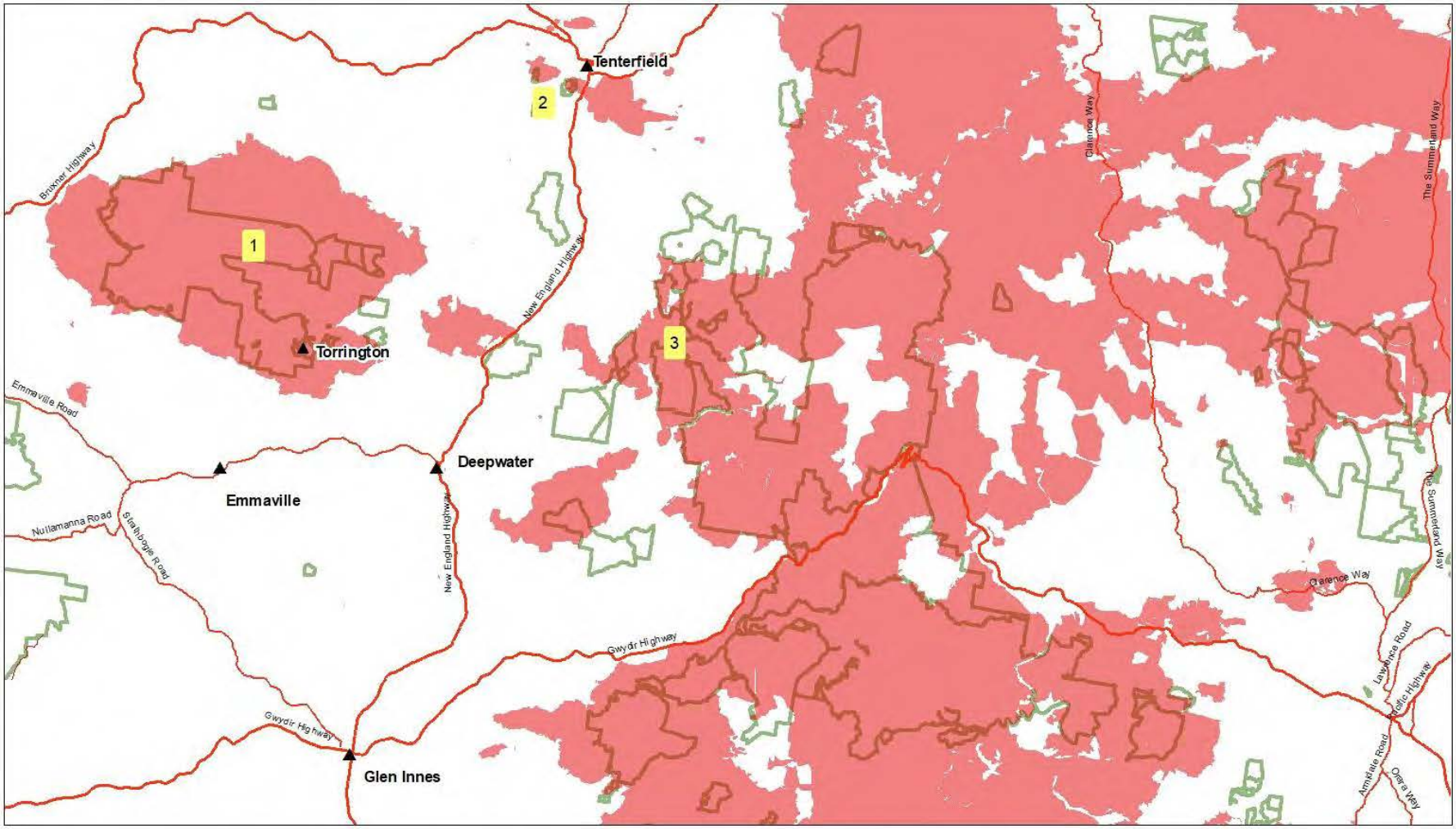

Figure 1. Area burnt in the 2019-20 wildfire and potential project (BRCG000171) locations:
1 - Torrington; 2 - Tenterfield; 3 - Spriabo

Burnt Areas 2019-20
National Park Estate

N

Datum/Projection: GDA 1994 MGA Zone 56

Tree Hollows

Tree hollows develop through decay, insect attack, excavation by termites, breakage of branches and fire (Gibbons and Lindenmayer, 2003; Hunter, 2015a). Fire has a role in the replacement of hollows in forests and woodlands by contributing to hollow development. This occurs by killing or damaging trees and exposing them to decay or directly excavating hollows. While fire may hasten hollow formation in younger trees, fires remove larger older trees by under-burning the trunk and causing the tree to fall, reducing hollow numbers (Woinarski et al., 1997; Gibbons and Lindenmayer, 2003; Courtney and Debus, 2005). Croft at al. (2016) provided evidence for this, as the percentage of mature trees increased in their study with time since fire on the Northern Tablelands and North West Slopes. Similarly, the 27 Glossy Black Cockatoo nesting hollows followed by Cameron (2006a) in Goonoo State Forest near Dubbo were completely lost due to a wild fire in the forest in 2008 (Cameron, pers comm.) along with all recruitment trees. A single older mature tree may have more than ten hollows including those of the larger size classes (> 15cm diameter used by Glossy Black Cockatoos) missing from younger trees.

Depletion of hollows owing to wildfire and hazard reduction burning is one of the processes that contributed to the listing of loss of hollow-bearing trees as a Key Threatening Process in NSW (Threatened Species Conservation Act, 1995). Hollows are a key resource for birds (21% of birds on the Northern Tablelands and North West Slopes use hollows; Andren, 2004), arboreal mammals (all species, including all the gliders, within the GLENRAC region use hollows except koalas), bats (17 of 25 species in the region use hollows), amphibians and reptiles, through the provision of shelter, nesting, hibernation and roosting sites, and protection from predators. Open forests and woodlands in the GLENRAC region had one of the highest densities of hollows recorded in eastern Australia (Croft et al., 2016) (Figure 2, p7) and are important due to their loss and continuing attrition of this resource across the landscape.

Figures 2 and 3 (p7) highlight the loss of hollows in Torrington SCA due to the 2019 wildfires (post fire data from 46 sites, unpublished); 60% of all hollows were burnt. Reductions in hollows will cause declines in hollow dependent fauna assemblages (Glossy Black Cockatoos and gliders) and greater competition for remaining hollows and subsequent stress for remnant fauna, leading to flow-on effects for the functioning of the whole ecosystem (Hunter, 2015a).

There is a complete dearth of hollows in Curry's Gap SCA. This reserve was formally the Tenterfield town common and was extensively cleared for grazing and regenerating trees are too young to support hollows (Plates 1and 3, pp8,10) (cf. Barayamal National Park, also a former town common, adjacent to Inverell which supports 70 year old White Box regrowth and has no hollow bearing trees). Only two hollows (≈ 10cm diameter) were seen during an inspection of the reserve, traversing all trails, for potential artificial hollow installation locations. This partly explains the very low records of glider sightings in this reserve (Figure 4, p8); there are no Glossy Black Cockatoo records in or near Currys Gap SCA. A similar

inspection of Washpool National Park (Spirabo) found low hollow numbers (visual assessment only; no transect counts).

Eucalypt species form hollows at varying rates due to tree age, trunk diameter and wood properties (e.g., termite resistance) (Hunter, 2015b). Several authors note that large hollows take > 100 years to develop (Bennet et al., 1994; Gibbons and Lindenmayer, 2003; Lunt et al. 2006). The loss of hollows in the GLENRAC region due to wildfire and the damage and/or lack of recruitment trees in burnt forests and woodlands makes the placement of artificial hollows in trees in the selected habitat recovery locations a viable option to assist hollow dependant fauna.

Glossy Black Cockatoo hollows and food resources: revegetation and artificial nest box locations.

Glossy Black Cockatoos are small black-cockatoos that occur at low densities within forests and woodlands of eastern Australia (Higgins 1999). They are unobtrusive birds but are not rare in the eucalypt forests and woodlands of the Northern Tablelands (Figure 5, p14). They spend most of the day feeding quietly in low shaded trees of Casuarina and Allocasuarina species in groups of twos and threes. A cone is bitten from a branchlet, then seed-bearing chunks are broken off and the bird husks the seeds out using the tongue and lower mandible against the upper beak. The chaff, or chewings, fall to the ground leaving tell-tale signs (Plate 2, p9). Such trees should be used to collect seed for propagation and subsequent regeneration planting as a food source for recovery of Glossy Black Cockatoo populations (however, the timeframe for project BRCG000171 precludes this option). Birds select Allocasuarina species and individual trees within stands on the basis of cone abundance and profitability (Cameron et al., 2006; Cameron, 2006; Chapman, 2007), so it is desirable to use such trees as a seed source for raising seedlings for revegetation.

The principal food trees of Glossy Black Cockatoo in the GLENRAC area are *Allocasuarina littoralis* (Black Sheoak) and *A. torulosa* (Forest Oak) and these species will be used for revegetation plantings as part of project BRCG000171. *Casuarina cunninghamiana* (River Oak), *A. inophloia* (Stringybark Oak) and *Allocasuarina luehmannii* (Bull Oak) that occur in the project area are also identified as preferred food trees (Chapman, 2007). The latter is the predominant Allocasuarina species in Curry's Gap SCA (Plate 3, p10) while *A. littoralis* was the dominant species found during inspections of Torrington SCA and Washpool National Park (Spirabo) (Plates 4 and 5, pp10, 11).

All the Allocasuarina species are killed by fire (Plates 4 and 5, pp10, 11) and by extended drought (Plate 6, p11), however, they can resprout (Plate 7, p12) and germinate (Plate 8) after these disturbances. There was little seedling emergence detected, up to now, at the three project areas indicating that revegetation planting of food trees would be beneficial for initial Glossy Black Cockatoo recovery, especially after enduring the combined impact of fire and drought. Drought conditions resulted in the failure of Allocasuarina plants to produce seeds and caused the death of significant numbers of plants in Cameron's (2006) study near Dubbo

which resulted in the lack of any Glossy Black Cockatoo breeding the following year. Similarly, there was no breeding of any birds in 2019 on the Northern Tablelands and North West Slopes.

Glossy Black Cockatoos are strong fliers (up to 47kph) and have the capacity to move between food and water resources and nesting sites without incurring large energy costs (Cameron et al., 2006), although, revegetation sites should be with 10km of artificial nest box locations (Matt Cameron, pers comm.). The black-cockatoos select high quality habitat for foraging mediated by predation risk (Cameron et al. 2006). Therefore, revegetation planting on nearby (within 10km of nesting sites) private property should have a mix of species (Eucalypts, Acacias and Allocasuarinas) so the location will eventually provide cover and food resources.

The potential revegetation location in Curry's Gap SCA, at the junction midway along Curry's Trail and an unnamed track to the southeast, is a low-quality site (small, low fertility, where the shrub layer Allocasuarina is *A. luehmannii* - small cones and not a primary food tree, no suitably sized trees to install Glossy Black Cockatoo artificial nest boxes and no cockatoo records) and should be rejected in favour of possible higher quality private property sites. Notwithstanding this, the reserve should be used for artificial glider nest box placement and possibly 2-3 cockatoo tubes.

A potential revegetation site and artificial nest box node was inspected in Washpool National Park (Spirabo) and determined to be suitable for nest box installation and as a revegetation location (Figure 6, p16). The latter is within the burnt section of a trial *Pinus radiata* pine plantation established prior to the area being gazetted as a national park (Plate 9, p13). Radiata pine has a reported allelopathic affect (Guerrero et al., 2007; Cummings et al., 2012) but this affect appears to be negated by burning as eucalypt seedlings are beginning to germinate towards the edges of burnt sections of the plantation in Washpool National Park (Plate 10, p13).

Potential Glossy Black Cockatoo nest box nodes for Torrington SCA are mapped in Figure 7 (p16) and Curry's Gap SCA in Figure 8 (p17). Access to Node D at Torrington SCA is via private property while Node E is in Torrington State Forest; permission would need to be sought if these two nodes are employed.

Each node could have between 2 (Curry's Gap SCA) and ten Glossy Black Cockatoo nest boxes spaced at >50m intervals (Cameron, 2006) clustered in groups of up to ten per 20ha (Matt Cameron, pers comm). Cameron (2006) found that the relative probability of a hollow being used for nesting increased as the density of hollows increased and, because the number of nest sites in Torrington and Curry's Gap State Recreation Areas and Washpool National Park (Spirabo) are low (Figure 3, p7), he recommended (cf Goonoo Sate Forest – Cameron 2006) a strategy of maximising the density of large hollows in known nesting areas (Figure 7, p16). Glossy Black Cockatoo nests are typically clustered in the landscape (Garnett et al., 1999) and they try minimise the distance to foraging areas as females that remain at the nest during the day sometime forage in nearby stands of Allocasuarina.

Glossy Black Cockatoo Artificial Nest Box Design

Glossy Black Cockatoos breed in winter and produce a single egg in hollows with the following criteria:

(i) Greater than 8m in height from the ground
(ii) Situated in branches or stems > 30cm in diameter
(iii) Angle of branch or stem not more than 45º from vertical
(iv) Minimum entrance diameter >15cm diameter

Cameron (2006) also noted that Glossy Black Cockatoos prefer to nest in senescent trees or stags and 92% of the time nested in vertical or near vertical spouts. This should be the guiding principle in selection of the type of artificial nest hollow to be used.

The recommended hollow design to use should be based on the 'Cockatubes" used by 'Landcare – Serpentine Jarrahdale in Western Australia (Appendix i). It consists of the 1.2m high tube along with a 10cm strip of internal secured mesh the length of the tube to enable the birds to climb out of the tube and a metal base with drilled holes to allow rain water to drain freely. No top is required in order to emulate a natural spout.

Monitoring can be carried out several ways:

1. Field observation of bird behaviour at the nest site
2. Using an endoscope and collapsible pole, depending on hollow height above ground
3. Using a song meter to record any chick begging.
4. Motion cameras

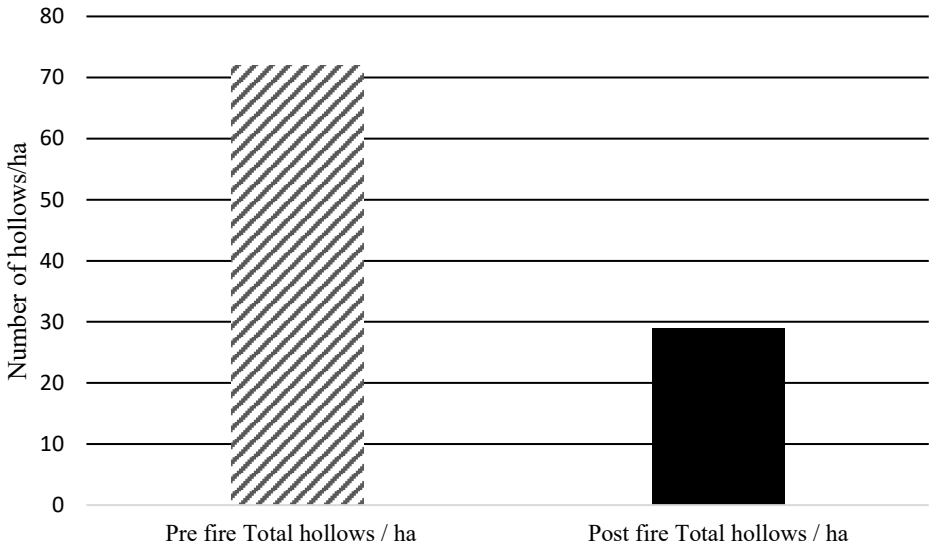

Figure 2. Hollow decline following 2019 wildfire – Torrington SCA (n = 46)

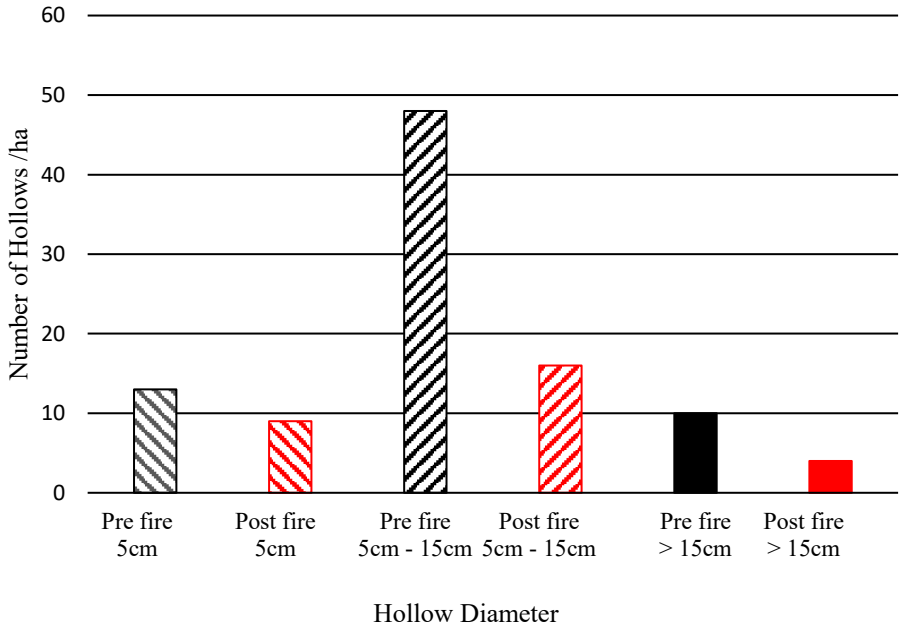

Figure 3. Hollow decline in size classes following 2019 wildfire – Torrington SCA

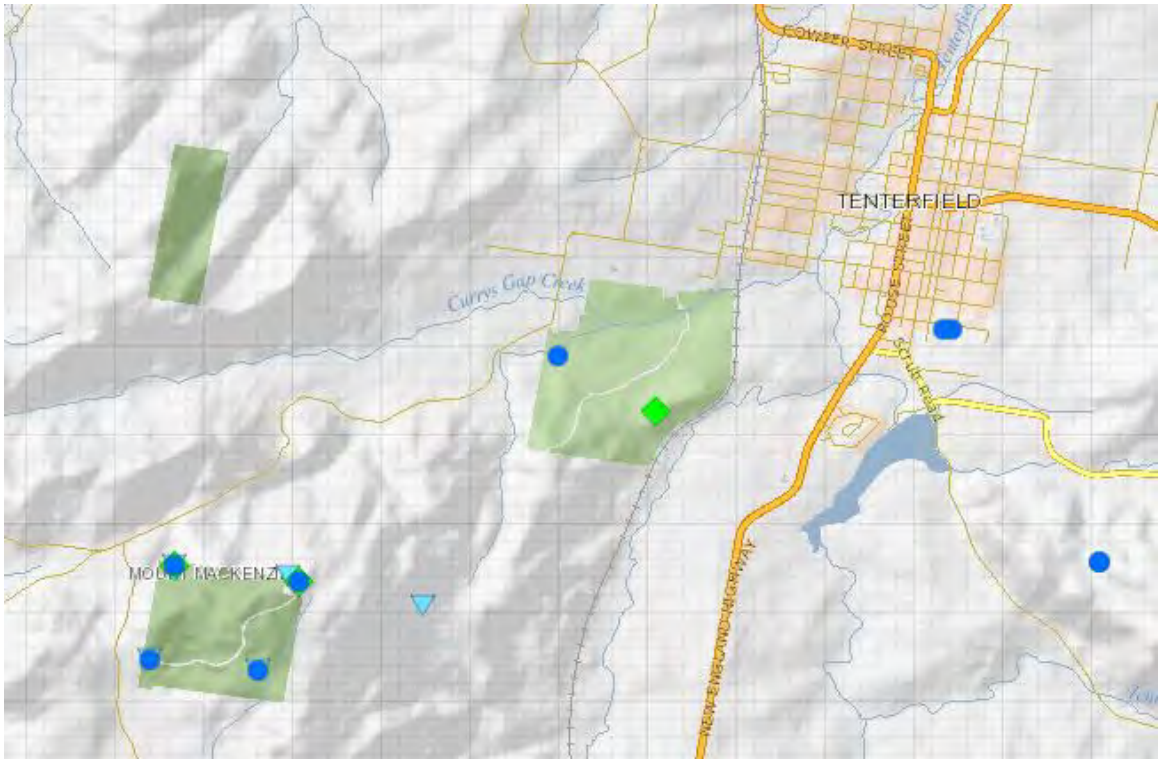

Figure 4. Wildlife Atlas glider species records for Curry's Gap SCA (Blue circle – Sugar Glider; Light blue triangle – Greater Glider; Light Green diamond – Squirrel Glider)

Plate 1. Regrowth eucalypts in Curry's Gap SCA. The trees are all too young to have hollows.

Plate 2. *Allocasuarina littoraslis* cone chewings under a feed tree that survived the 2019 fire. A single tree, in a copse of 25, was selected for feeding.

Plate 3. Regrowth woodland in Curry's Gap SCA with Allocasuarina luehmannii (Bull Oak) in the shrub layer.

Plate 4. Allocasuarina littoralis in the shrub layer killed by the 2019 wildfire in Torrington SCA

Plate 5. Allocasuarina littoralis lining Old Mill Trail in Washpool National Park, killed by the 2019 fire. This site has multiple Glossy Black Cockatoo sighting records (cf. Figure 5).

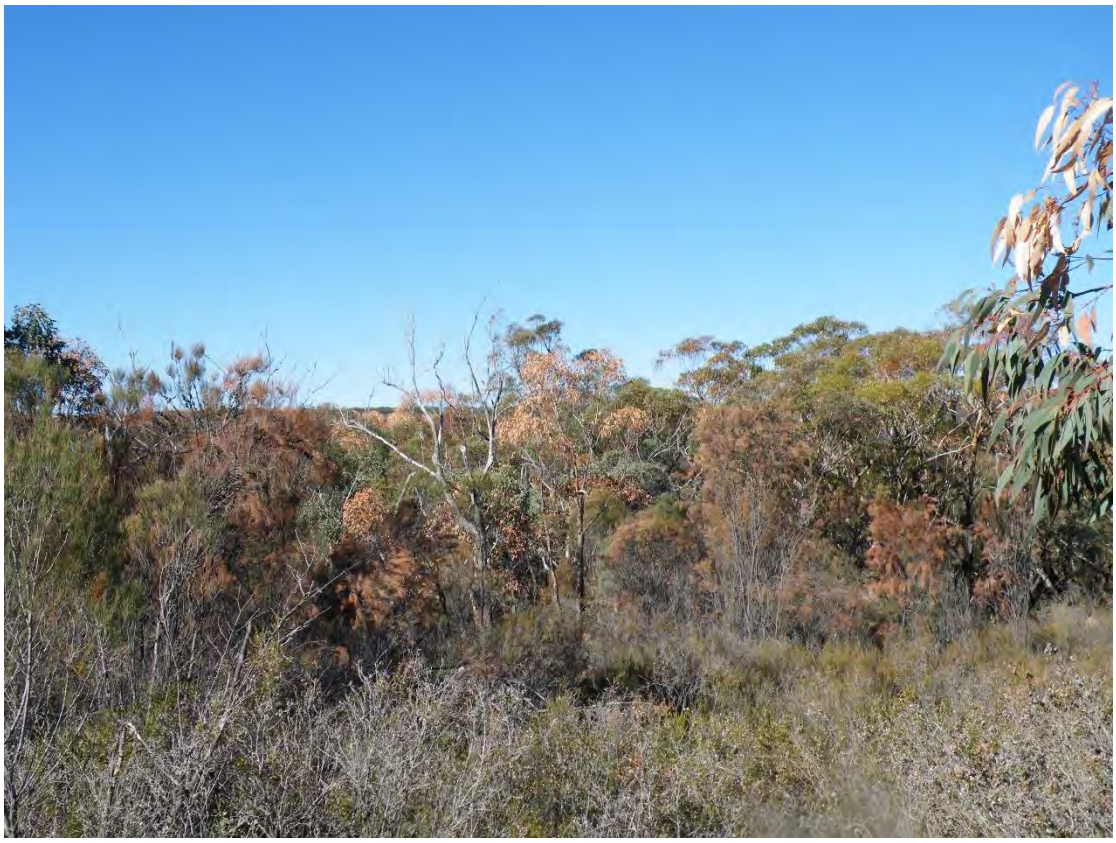

Plate 6. *Allocasuarina rigida* (Kings Plains) dying with the 2019 drought.

Plate 7. *Allocasuarina inophloia* (Stringybark Oak, Severn River) coppicing after drought. A similar response was observed in *A. littoralis*.

Plate 8. *Allocasuarina littoralis* germinating after the 2019 wildfire.

Plate 9. Allocasuarina revegetation site within a burnt Radiata pine plantation, Washpool National Park.

Plate 10. Eucalypt seedling germination in burnt Radiata pine plantation, Washpool National Park

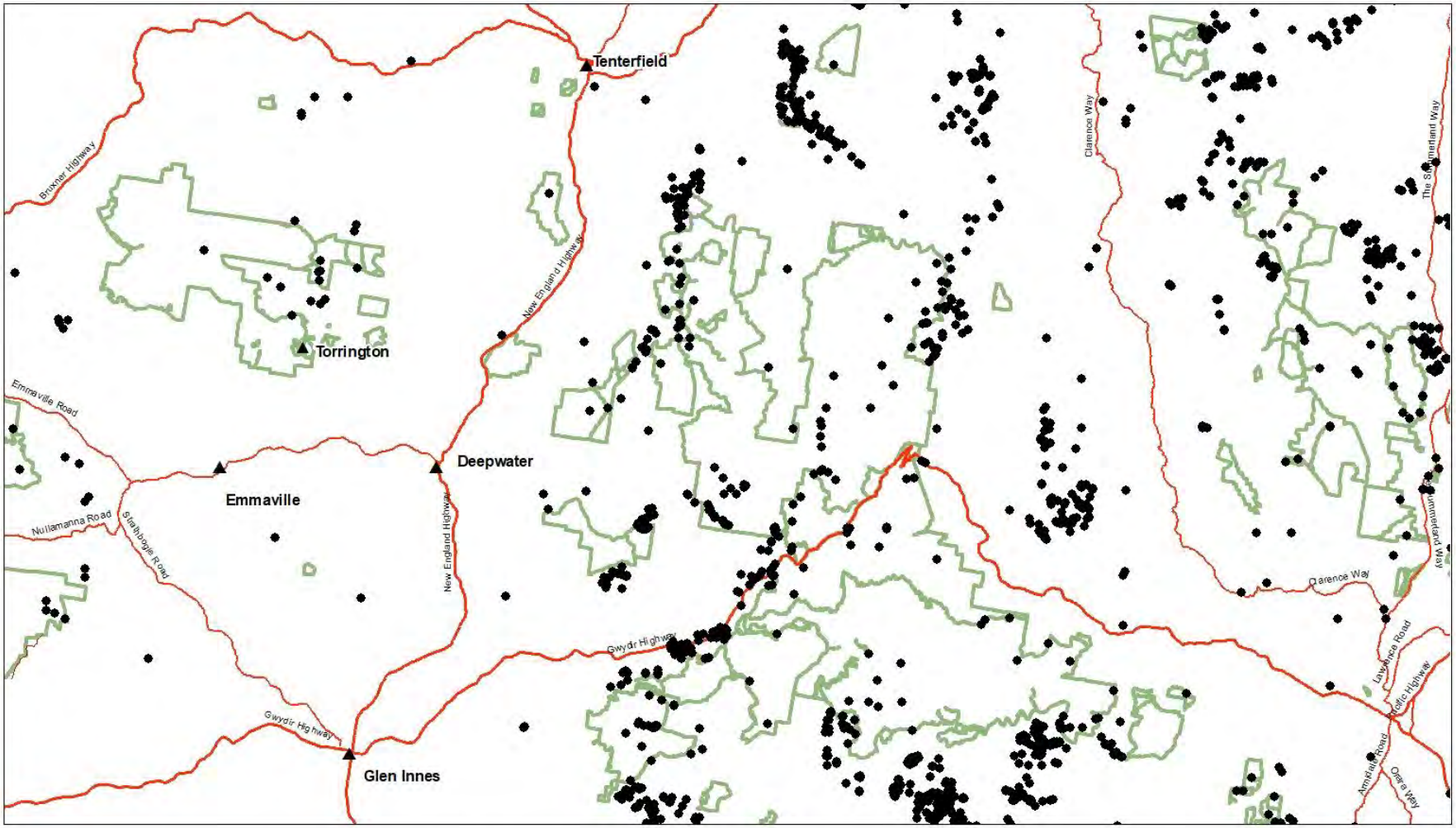

Figure 5. Glossy Black Cockatoo records - Northern Tablelands

National Park Estate

Glossy Black-Cockatoo

Datum/Projection: GDA 1994 MGA Zone 56

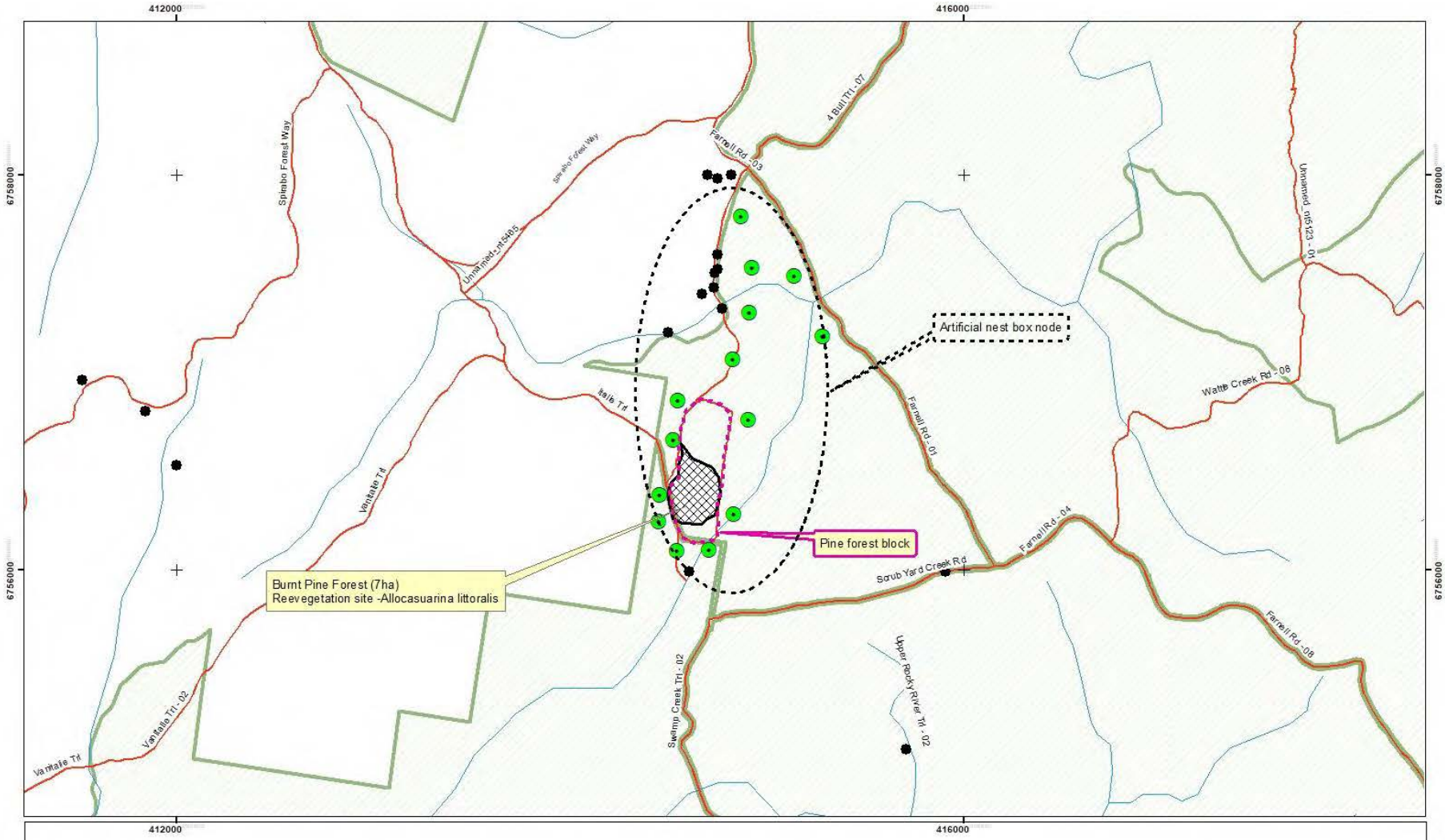

Figure 6. Washpool National Park (Spirabo)
Artificial nest box locations and potential revegetation site

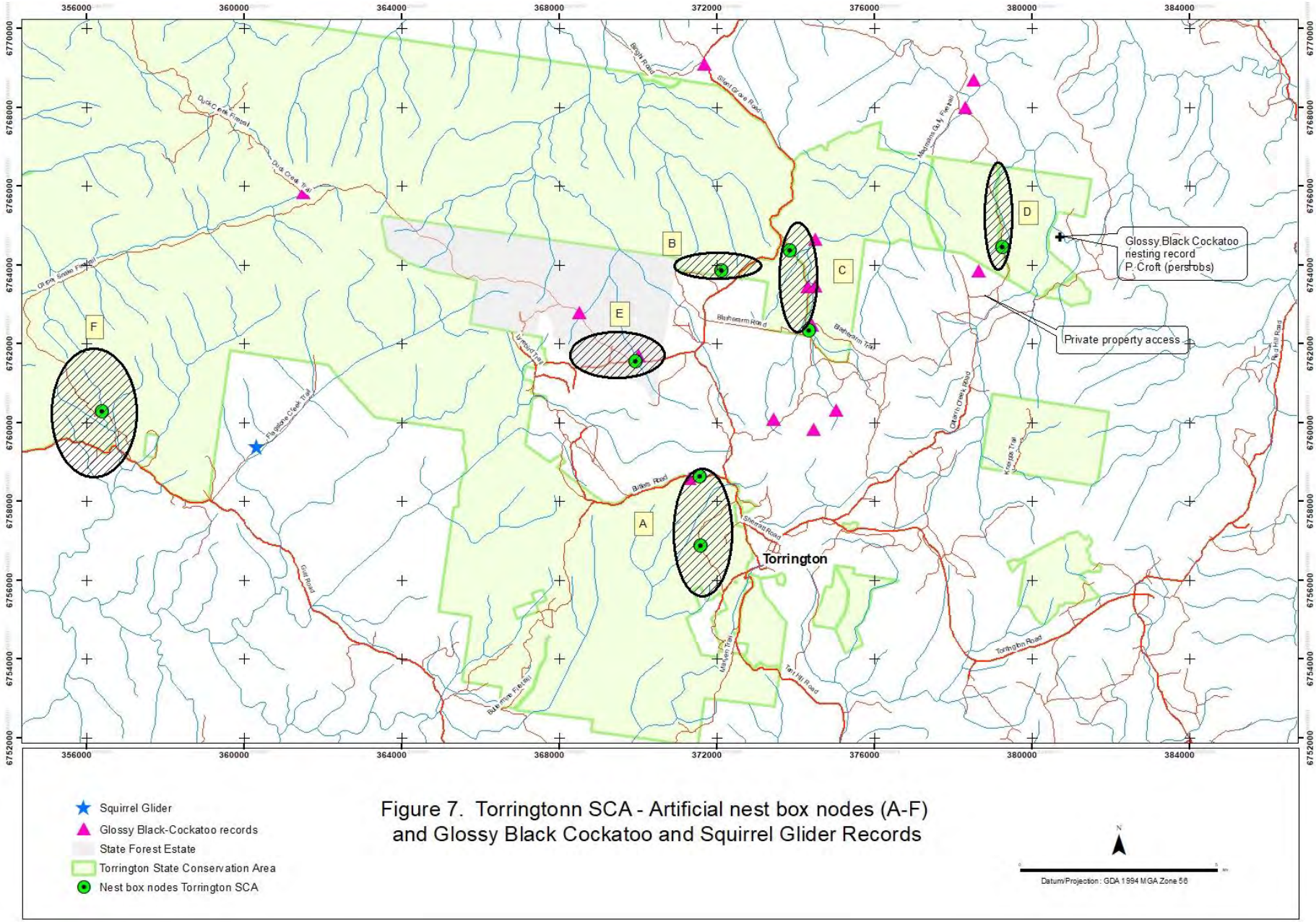

Figure 7. Torringtonn SCA - Artificial nest box nodes (A-F) and Glossy Black Cockatoo and Squirrel Glider Records

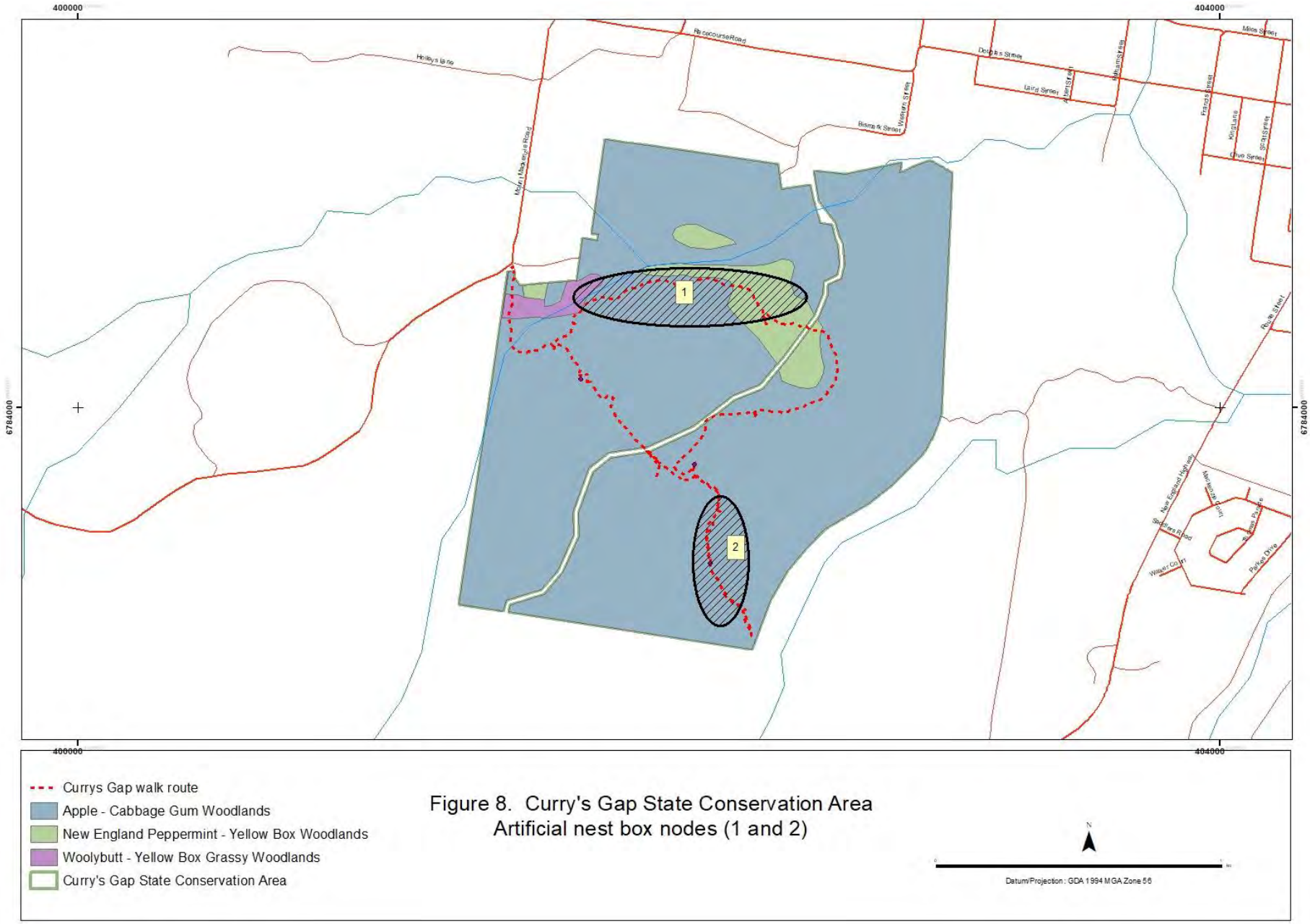

Figure 8. Curry's Gap State Conservation Area
Artificial nest box nodes (1 and 2)

Glider Hollows

There are five species of gliding possums in the GLENRAC area: Greater Glider, Yellow-bellied Glider, Squirrel Glider, Sugar Glider and Feathertail Glider (Figure 9, p19; Figure 10, p20). All gliders use hollows for shelter and nesting and hollows are critical for their survival because they rely on them all year round and cannot move quickly over large distances to find new dens after hollow loss (Goldingay 2021). Gibbons et al. (2002) and Goldingay (2021) provide detailed accounts of the characteristics of nest and shelter trees used b gliders and summarise key points that relate to the size of the trees used, the size of entrances of hollows and an indication of the spacing of the trees used. This data will be crucial for the GLENRAC 'Homes and Habitat for Gliders' project (Table 1 – reproduced from Goldingay, 2021).

Greater Gliders are common in forests to the east of Glen Innes and have been recorded in the Ben Lomond area but generally are scarce further west on the tablelands, apart from the Torrington area (Figure 9, p19). Similarly, Yellow-bellied Gliders inhabit forests to the east of town (e.g. Butterleaf National Park; Plate 11, p19) although there is an isolated population in Tingha Plateau State Conservation Area. Therefore, project BRCG000171 will concentrate on the smaller three species of glider: Squirrel Glider, Sugar Glider and Feathertail Glider and the Greater Glider which all have a wide distribution in the GLENRAC area. However, artificial nest boxes for Yellow-bellied Gliders and Greater Gliders would be suitable for installation in Washpool National Park (Spirabo).

The Greater Glider is the largest of the gliding possums and is adapted to an exclusive diet of eucalypt leaves. It does not need to drink due this diet. They rest during the day in tree hollows, are essentially solitary and territorial, although family groups use multiple den trees in their home range.

The Yellow-bellied Glider has a staple diet of nectar, pollen and sap of eucalypt trees (Plate 11, p19) and insects. They are gregarious and live in groups (up to 6) and share a den in a hollow tree.

Table 1. Den and tree hollow attributes used by focal species. Values are the range in mean values. (cm). Numbers in brackets show the number of studies contributing to those values. NA= not available; *includes nest box studies; [a]short-term areas only. Dens per ha is based on the number of primary dens per home range area.[1]Studies contributing to these values have this superscript in the text describing home ranges and den trees.

Species	DBH	Entrance diameter	% dead trees	Den spacing	Home range (ha)	[1]Dens per ha
Greater glider	58–128 (2)	18 (1)	7–16 (5)	20–150 (2)	1–3 (4)	1 (2)
Yellow-bellied glider	73–160 (3)	11 (1)	0–2 (4)	50–500 (3)	30–65 (3)	0.1 (3)
Squirrel glider	41–93 (5)	<5 (3)	8–54 (6)	20–300 (2)	5–15 (3)	0.4–0.6 (3)
Sugar glider	NA	<5 (3)*	NA	20–50 (3)*	4–5 (2)	0.4 (3)
Feathertail glider	66 (1)	<3 (4)*	NA	20–100 (4)	[a]0.2–2.1 (2)	NA
Brushtail possums	>70 (3)	10–20 (2)*	NA	20–100 (2)	2–6 (2)	1 (2)
Brush-tailed phascogale	>40 (3)	2.5–4.5 (3)*	5–35 (3)	10–400 (2)	15–120 (1)	0.1 (3)
Eastern pygmy-possum	57 (1)	<3 (4)*	20 (1)	10–200 (2)	3–4 (1)	0.3

(Goldingay, 2021

Plate 11. Characteristic ‘V’ shaped feeding scars left by Yellow-bellied Gliders, Butterleaf National Park. Sap accumulates at the base of the ‘V’ Sugar and Feathertail Gliders take advantage of this food resource.

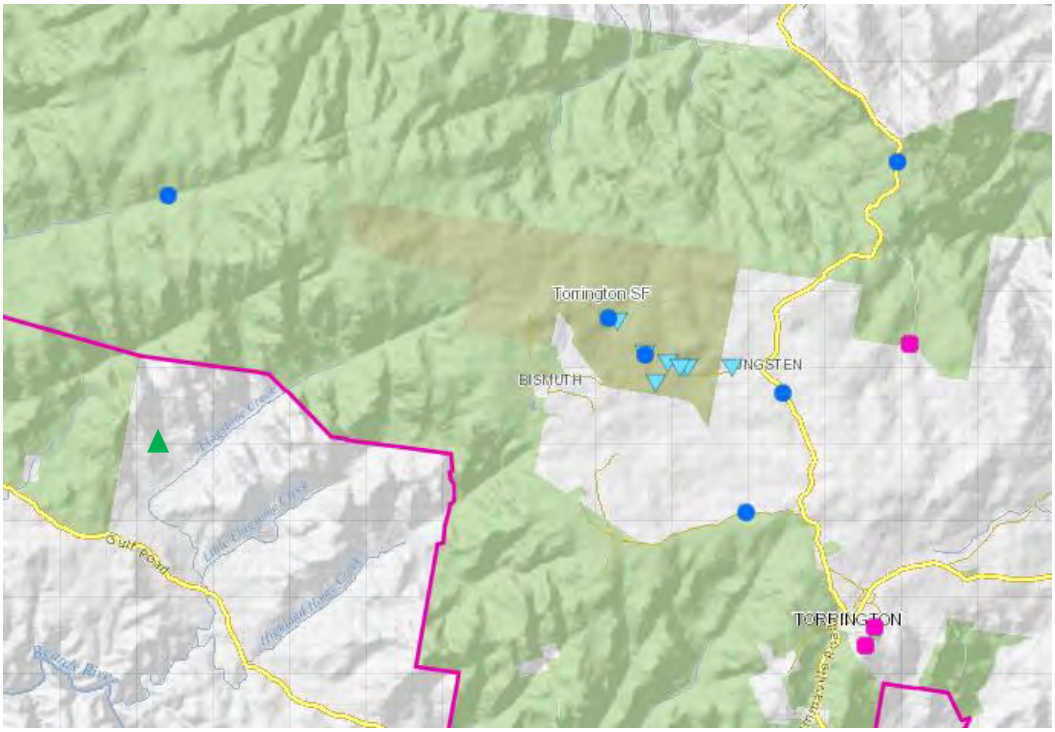

Figure 9. Glider records near Torrington (Blue triangle = Greater Glider; Blue circle = Sugar Glider; Purple circle = Feathertail Glider; Green triangle = Squirrel Glider

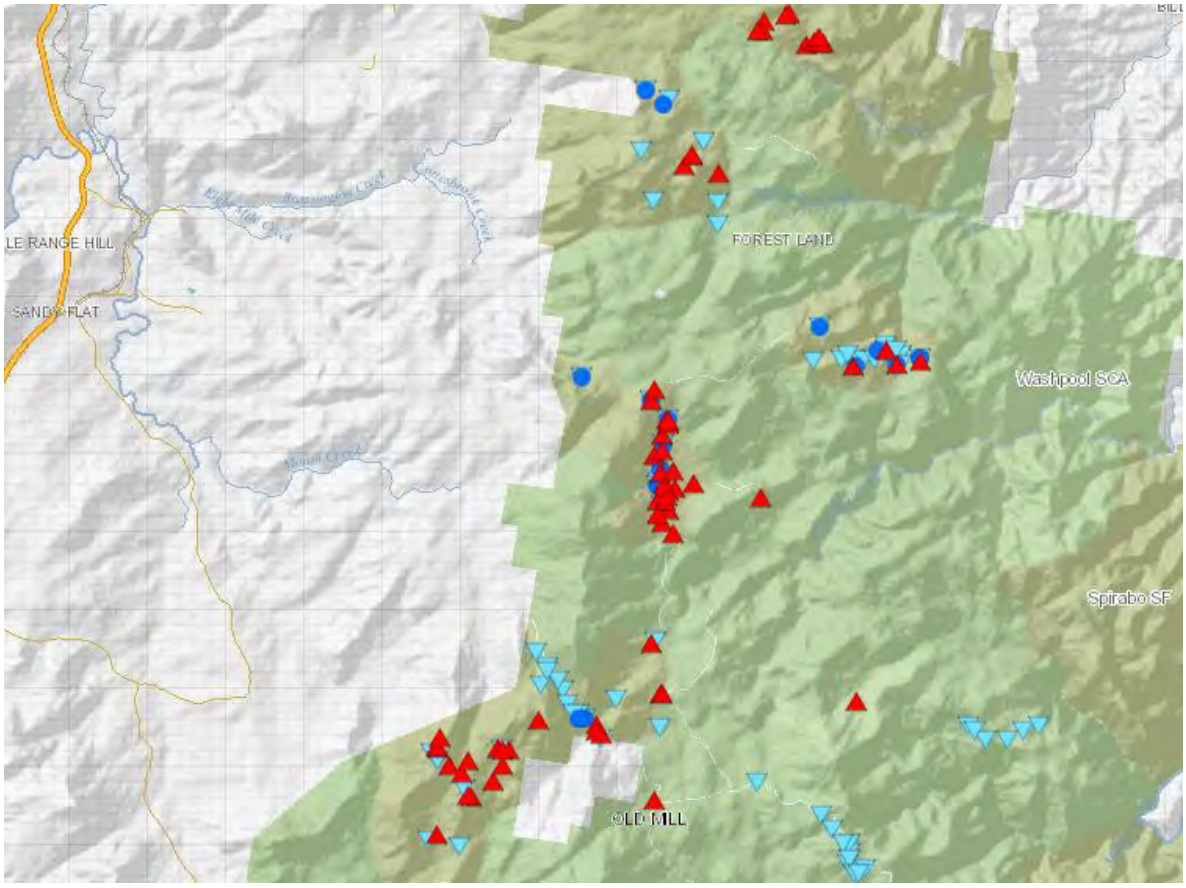

Figure 10. Glider records Washpool National Park (Spirabo) (blue triangle = Greater Glider; blue circle = Sugar Glider; purple circle = Feathertail Glider; red triangle = Yellow-bellied Glider.

Sugar Gliders are locally common (up to 10/ha in forests and woodlands) where tree hollows are available for shelter and there is abundant food such as the gum produced by acacias, the sap of certain eucalypts, invertebrates and exudates of invertebrates.

The Squirrel Glider is twice the size of the Sugar Glider and is rarer and more restricted in its range. The Squirrel Glider nests in a leaf-lined nest hollow and its diet is similar to the Sugar Glider while both species have been reported feeding on small birds and their eggs.

The Feathertail Glider is the smallest of the gliders (they weigh around 12grams and are the size of a mouse compared to a Greater Glider that can weigh up to 1.6kg) and is widely distributed in the GLENRAC area. They feed on nectar (e.g. banksias, Plate 12, p21), manna and the sugary sap made by other marsupials (e.g. Plate 11, p19). They build globular nests of dried overlapping eucalypt leaves in hollows where up to 16 individuals have been recorded from a single nest (Strahan, 1983).

Plate 12. Burnt *Banksia integrifolia* (*Node F, Figure 7, p 160) in the understorey, Carpet Snake Trail in Torrington SCA, an important food source for Feathertail, Sugar and Squirrel Gliders.

All the gliders use multiple hollows of various sizes within their home territories and even the same tree (Gibbons et al., 2002). Smith et al. (1994) found the abundance of Greater Gliders was significantly higher with greater abundance of tree hollows and was absent from sites with fewer than six hollow trees per hectare. They require at least 2-4 live den trees per hectare because their home ranges are relatively small (1-4ha in high quality forest but up to 16ha in low quality forest and woodlands - artificial hollow placement should reflect this density). They also note that Greater Gliders are sensitive to wildfire and slow to recover from major disturbances (such as the 2019 wildfire).

Seasonal movement may also lead to occupancy of multiple hollows in response to available food supplies e.g., Yellow-bellied Gliders (which have a large home range between 35-65ha) concentrates its feeding in different parts of its home range during the year. Gliders use multiple hollows to reduce numbers of parasites they may be subject to by moving to 'clean' nest sites in other trees. They also move to avoid predation.

Gibbons et al. (2002) summarise the number of hollows used by the gliders (including those in project BRCG000171): number of nest tees used per hectare and number of hollows used (in brackets):

Greater Glider: 0.5-25 (2-18); Yellow-bellied Glider: 0.2-0.4 up to 13); Sugar Glider: 1-10 (up to 5); Feathertail Glider: 1-10 (up to 5).

Trees with many hollows typically contain hollows with a range of different dimensions and there is evidence of habitat partitioning between sympatric species of hollow using fauna (Gibbons et al. 2002). This suggest that a range of artificial hollow sizes should be available in selected trees to accommodate the array of gliders in any area (e.g. Plate 13 below).

Plate 13. Artificial nest boxes closely spaced (≈ 6m high) installed near

Granite Lookout in Washpool NP

In summary (Goldingay, 2021):

Greater gliders prefer:

- Large live DBH trees (≥100cm) and a relative high density of these trees
- Large volume hollows (i.e. large opening into wide section of trunk)
- Entrances <20cm diameter

Yellow-bellied Gliders prefer:

- Large live DBH trees (>100cm)
- Large volume hollows (i.e. large opening into wide section of trunk)
- Relatively narrow (≈10cm) entrances

Squirrel Gliders prefer:

- Live or dead hollow-bearing trees with larger dbh trees (≥50cm)
- Branch and trunk hollows equally
- Hollow entrances <5cm diameter
- Multiple potential den trees at approximately0.5 per ha

Sugar Gliders prefer:

- Live or dead hollow-bearing trees
- Branch and trunk hollows equally
- Hollow entrances <5cm diameter
- Multiple potential den trees at approximately0.5 per ha

Feathertail Gliders prefer:

- Live or dead hollow-bearing trees
- Branch and trunk hollows equally
- Hollow entrances <3cm diameter
- Larger cavities with narrow entrances when they den communally

Nest box designs for gliders

The different species of gliders have preferences for certain hollow attributes including hollow entrance size (see above), cavity size and thermal properties. There are three main hollow designs / techniques that address these requirements:

1. Nest boxes constructed from marine ply or hollow logs. Appendix iv and Appendix v provide detailed designs for each species of glider.
2. Carving hollows in tree trucks with a chainsaw
3. Carving hollows in tree trucks and large branches with a "Hollowhog" which creates a large cavity through a small hole in short time (Appendix vi)

The designs have different advantages and disadvantages. Nest boxes need ongoing maintenance, chainsaw hollows are time consuming and remove a substantial portion of the trunk diameter, possibly weakening the tree, and the "Hollowhog" needs extra equipment / tools (which can be hired) and a minimum tree diameter to prepare a hollow (e.g. the majority of the regrowth vegetation at Curry's Gap National Park has dbh's too small for carving hollows and the only opotion would be nest boxes). All have various levels of safety concerns.

A combination of nest boxes and "Hollowhog" would be suitable for glider hollows for project BRCG000171.

Recommendations

The intense wildfire in 2019 caused a severe population decline of gliders and Glossy Black Cockatoo due to burning death, along with loss of nesting hollows and food resources. Assisted recovery of these populations in Torrington State Conservation Area, Curry's Gap State Conservation Area and Washpool National Park (Spirabo) is recommended:

1. Install 50 artificial Glossy Black Cockatoo "Cockatubes" at the nest nodes identified in Figures 6,7 and 8 (pp15-17) using the design and attachment method in Appendix (i) and material in Appendix (iii). Installation height 8-10m; leave top open; fit 10cm internal ladder of mesh the length of the tube; turned internal base with drilled holes; 20cm fine ground bark chip. Density = 10 hollows per 20ha at least 50m apart. All nodes ave trail access for a 'cherry piocker'.
2. Node D (Figure 7, p16) is a site closest to a known Glossy Black Cocatoo nest would be accessed via private property
3. Install / carve 50 glider hollows with 3, 5 and 10cm entrance diameters and various internal dimensions (Appendix v) at the nodes identified in Figures 6,7 and 8 (pp15-17). Use a combination of nest boxes and "Hollowhog" bored hollows suitable for the glider species. Installion height 6-10m. Hollows can be placed in the same trees as the 'Cockatubes' if convenient.
4. Node E (Figure 7, p16) is within Torrington State Forest but should be considered as the Torrington pendant has higher fertility soil (with preferred eucalypt leaf nutrition) and is the only location with Greater Glider records in the area (Figure 9, p19).

Dr Peter Croft

21/8/2021

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Appendix (i)

LANDCARE SJ
Serpentine - Jarrahdale

(08) 9526 0012

12 Paterson Street

Mundijong, WA 6123

info@landcaresj.com.au

The **COCKATUBE ®** nest box

The **COCKATUBE ®** nest box has been designed specifically for the 4 species of Black Cockatoo found in Western Australia, but is suitable for Black Cockatoo species Australia wide.

With some maintenance the **COCKATUBE ®** is expected to last over 50 years.

Recommended by DBCA (Dept. Biodiversity, Conservation and Attractions) as optimum hollow dimensions for WA Black Cockatoos, and suitable for all Australian species of Black Cockatoos.

Landcare SJ can provide a full installation service or installation advice.

You can install the **COCKATUBE ®** yourself and Installation Guidelines are available at purchase.

Generally a cherry picker or tree climber (preferably an arborist) will be required.

1200mm x 375mm

PRICE $460

Appendix (ii)

Hollow Log Homes

Website | Directions | Save

Manufacturer in the Cambroon, Queensland

Address: 149 Chinaman Creek Rd, Cambroon QLD 4552

Hours: Closes soon · 3PM · Opens 8AM Fri ▾

Phone: (07) 5472 3142

Home / Shop By Pest / Birds / Cockatoo Nesting Box

Cockatoo Nesting Box

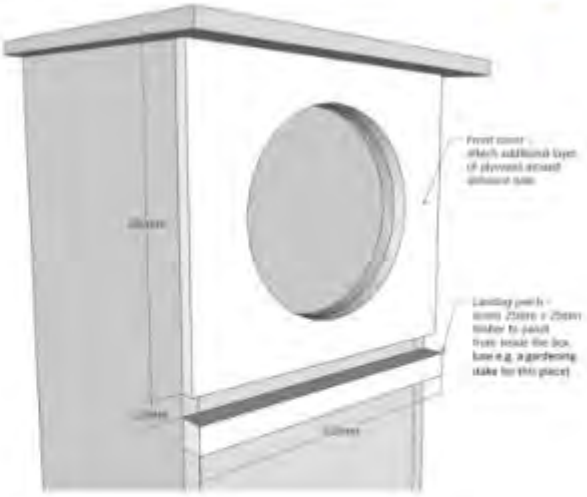
$399.00

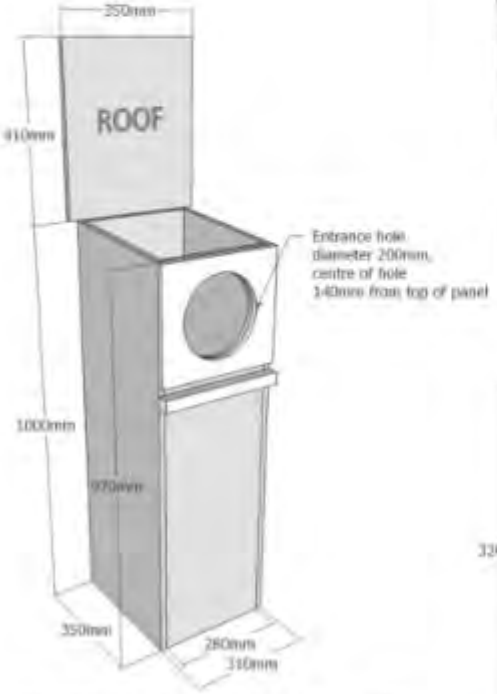
Cockatoo Nesting Box

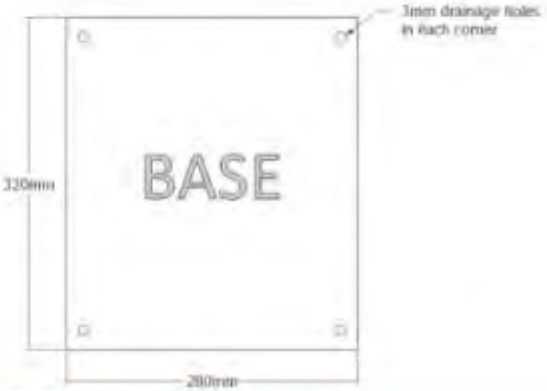
✓ 1 in stock

ADD TO CART

Interest free finance







Compiled by Alice McGlashan @ NestBoxTales
Graphics assistance by Jenny Bigelow

Appendix (iii)

Recycled plastic pipe (6m lengths x 375mm) for possible manufacture of cockatoo artificial nest tubes.

Metal spinners - turn ‘pie dish’, and drill holes, to fit inside tube as base of nest :

e.g. Metal Spinning Services

Appendix (iv)

Hollow Log Homes

Website | Directions | Save

Manufacturer in the Cambroon, Queensland

Address: 149 Chinaman Creek Rd, Cambroon QLD 4552

Hours: Closes soon · 3PM · Opens 8AM Fri

Phone: (07) 5472 3142

HOME / SHOP ONLINE / CYPLAS

Glider

$177.00

Our Glider box is designed for sugar and squirrel gliders. This box is also used by tree creepers and scaly breasted lorikeets.

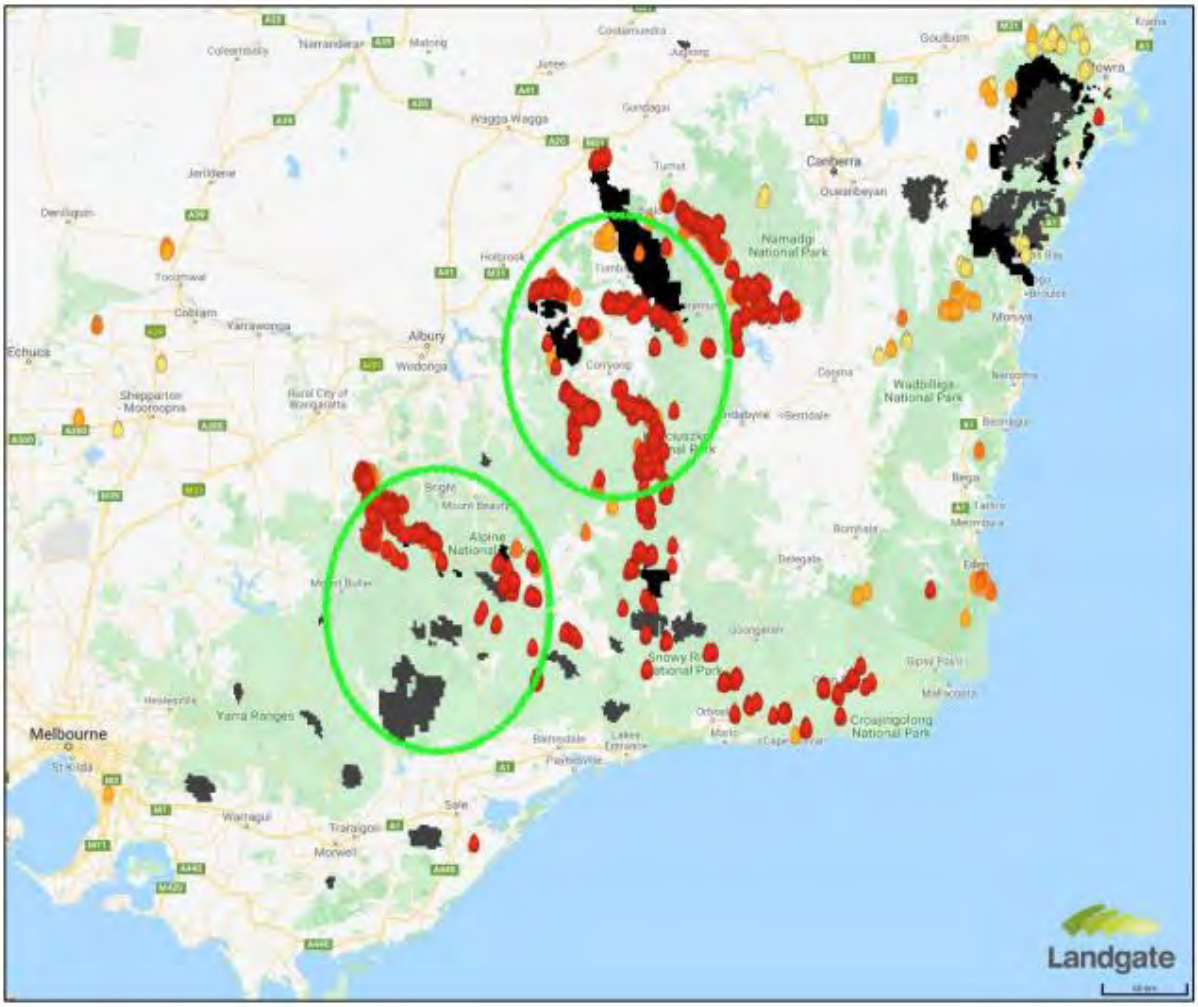
- 1 + ADD TO CART

Category: CYPLAS

Appendix v

Hollow Using Species List & Nest Box Designs

For the High Country Bushfire Zones



Compiled by Alice McGlashan
Facebook: https://www.facebook.com/groups/nestboxtales/
Website: www.nestboxtales.com
Sharing stories and knowledge about nest boxes for Australian native animals to encourage everyone to improve habitat for wildlife.

Mammals	Entrance diameter	Nest box height
Agile Antechinus	30mm	2-4m
Dusky Antechinus	30mm	2-4m
Feathertail Glider	30mm	2m
Greater Glider (southern subsp.)	130mm	6-10m
Squirrel Glider (V)	50mm	4-8m
Sugar Glider	50mm	4-8m
Yellow-bellied Glider (V)	80mm	6-8m
Microbats (several species) (V)	30mm hole, 20mm slot	3-5m
Common Brushtail Possum	90-150mm	4-8m
Mountain Brushtail Possum	90-150mm	4-8m
Leadbeater's Possum (T) – old growth Mountain Ash, Alpine Ash		
Eastern Pygmy Possum (V)	25mmm	
Mountain Pygmy Possum (E)	25mmm	
Ringtail Possum	60-80mm	4-8m

Small Nest Box Dimensions (Birdlife Red-rumped Parrot nest box)

Width	Length	Height
200mm	200mm	500

Entrance Diameter	Species
30mm	Mountain + Eastern Pygmy Possum, Feathertail Glider, Antechinus species, Tree Martin
40mm	Feathertail Glider, Antechinus species, Tree Martin
50mm	Sugar Glider, Squirrel Glider, Treecreeper species
60mm	Red-rumped Parrot, Treecreeper species

Medium Nest Box Dimensions (Birdlife Crimson Rosella nest box)

Width	Length	Height
230mm	260mm	500mm

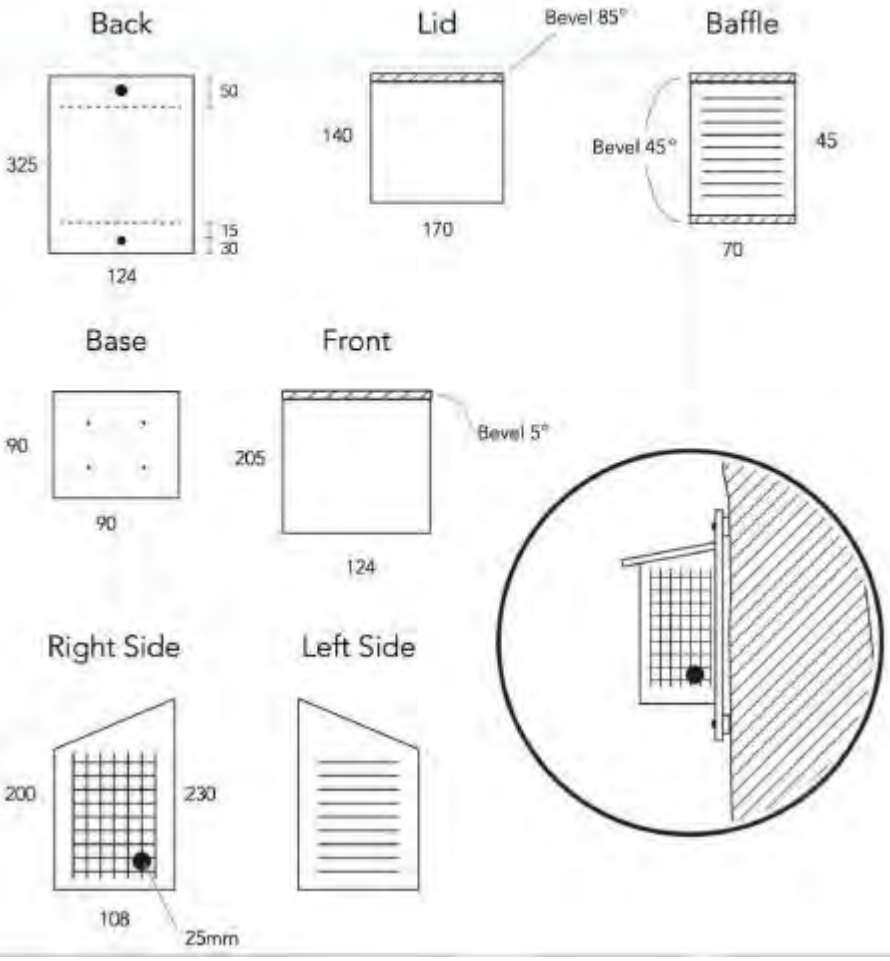
Entrance Diameter	Species
40mm	Sugar Glider, Musk Lorikeet, Little Lorikeet
50mm	Squirrel Glider, Sugar Glider,
65mm	Ringtail Possum, Eastern Rosella
75mm	Crimson Rosella, Eastern Rosella, Dollarbird, Ringtail Possum, Australian Owlet-nightjar, Sacred Kingfisher

Large Nest Box Dimensions (Scaled up Birdlife Crimson Rosella nest box)

Width	Length	Height
250mm	300mm	500mm

Entrance Diameter	Species
80mm	Yellow-bellied Glider, Ringtail Possum, Crimson Rosella, Eastern Rosella
90mm	Ringtail Possum, Crimson Rosella
100mm	Brushtail Possum, Owl species, King Parrot, Galah
130mm	Greater Glider (southern sub species), Brushtail Possum, Duck species, Owl species, Gang-gang Cockatoo, Galah, Corella species
150mm	Brushtail Possum, Duck species, Owl species, Galah, Sulphur-crested Cockatoo, Corella species

Feathertail/Antechinus/Pygmy Possum (17mm ply)



Prepare the Pieces

1. Cut timber to the dimensions below to make the pieces. Dimensions are for 17 mm ply and will need to be adjusted for other materials.
2. Bevel cut the rear edge of the lid at 85°, and the front 5° to match. This is critical so the lid will sit!
3. (optional) Bevel the edges of the baffle to help it fit snug
4. Use a hole saw to cut the large entrance hole (25 mm) in the right side panel. A side entrance is easier access for possums than a front one.
5. Prepare for assembly. Drill pilot holes into plywood before screws to avoid splitting. It's good to countersink the holes as well in preparation for the screws. It can help to tack together the box with a nail gun before inserting the screws – this makes it easier to assemble and ensures everything fits together well.
6. Drill holes for the support screws in the back panel. Drill some small holes in the base panel for drainage
7. Use a bench saw or router to cut a grid in the side panel, internal sides, and both sides of the baffle. This will give animals something to grip when climbing into the box – or you can place a small branch inside for them to use.

Construction

8. Prepare the joints with Silastic or similar sealant and screw together the back, front, sides and base of the box
9. Nail or screw the baffle inside the box. The baffle gives the box some protection from the outside elements and reduces the use by pest species or predators
10. Install the lid. (Optional) Install the piano hinges to connect the lid and the main box. You may need to add a hook & eye latch to keep the lid firm on these smaller boxes

Installation

12. Select a suitable site for your installation and erect a ladder (remember safety first)
13. Add two handfuls of your insulation (e.g. paperbark etc) to make the box cosy
14. (optional) Dip the installation screws in organic lubricating oil (e.g. Lanotec) to coat and avoid rusting
15. Carefully climb the ladder and install the upper support screw.

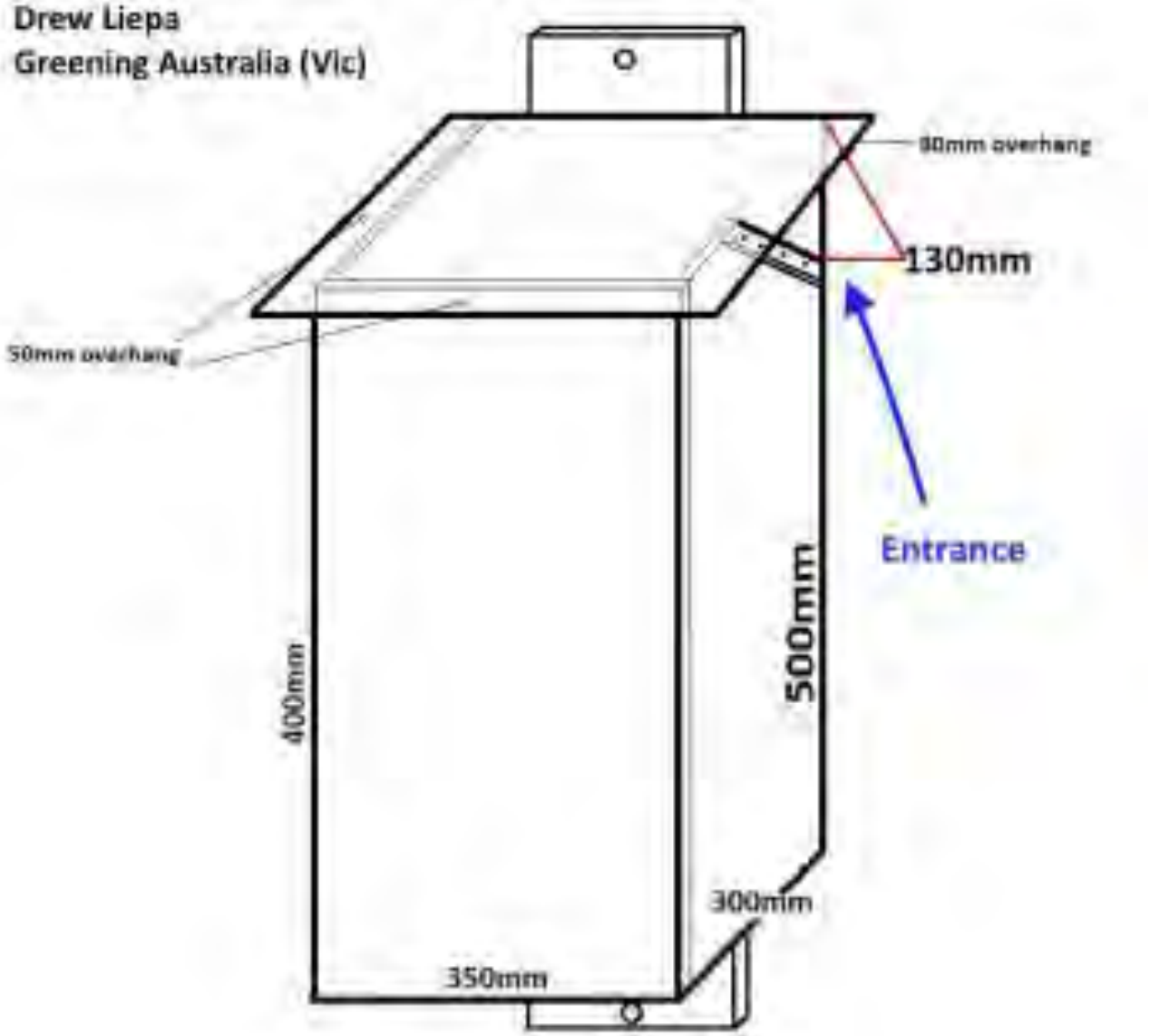
    a. Drill a 3/16 hole into the tree at the designated height

    b. Screw in the upper 100mm Tek Screw through the box and PVC spacer

    c. Now screw in the lower screw and use a hex driver to tighten if necessary.
16. Your nest box should now be ready for use. Congratulations!

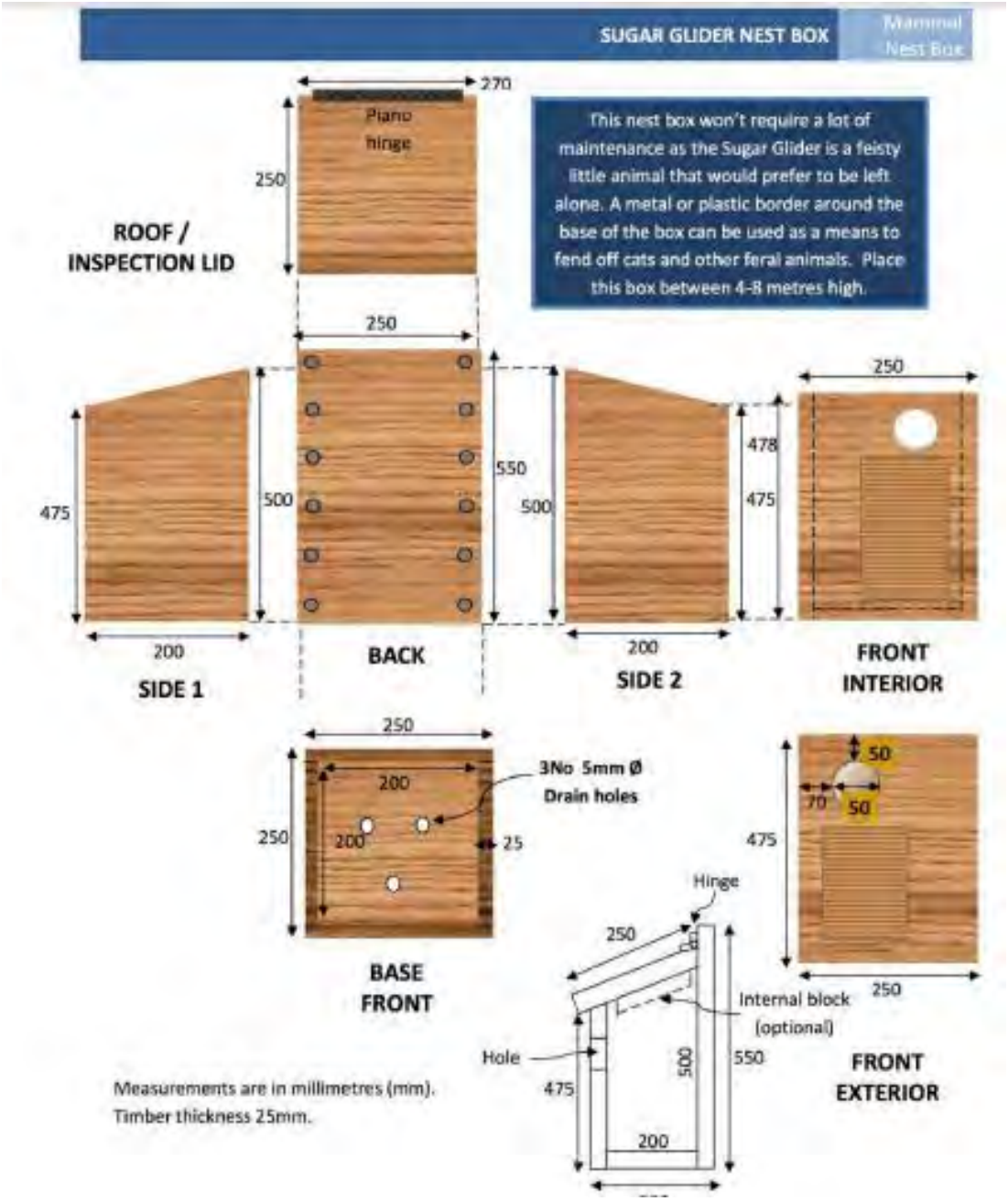
Greater Glider nest box design

Drew Liepa
Greening Australia (Vic)



Greater Glider nest box design instructions (please contact Drew if you make this nest box – a project is underway):
Basic version is made with 18MM MARINE PLY.
We line the box with shredded bark and leaves before screwing the lid down.
We paint the outside with a light green to help prevent them deteriorating.
THE TRIANGLE 130MM IS THE ENTRY HOLE AND IS ALWAYS UP AGAINST THE TREE.
You can use a hole saw and cut round hole although we find the triangle works really well. One of the pics shows the triangle box being used.
NO DRAINAGE HOLES.
It's important the box is well sealed. We did put a few bits of wood on top for grip but the GG's have massive claws and don't really need them. Easy to do though.
We installed all ours at A HEIGHT BETWEEN 15 AND 30M using tree climbers. This will depend on the tree species and the overall height of the trees in your landscape.
All our nest boxes are positioned on the SOUTH EASTERN side of the tree.
This is important to prevent over heating in summer.
The basic version has been shown to work without insulation
We install on average 10 PER HA.
NB. Consolidate the existing habitat that's not burnt. GG's don't appear to use burnt out hollows for years.

Drew Liepa I Senior Program Officer | Greening Australia
PO Box 237, Leongatha, VIC 3953
| **M** 0439557304 | **W** www.greeningaustralia.org.au


SUGAR GLIDER NEST BOX
Mammal Nest Box
270
Piano hinge
250
ROOF / INSPECTION LID
This nest box won't require a lot of maintenance as the Sugar Glider is a feisty little animal that would prefer to be left alone. A metal or plastic border around the base of the box can be used as a means to fend off cats and other feral animals. Place this box between 4-8 metres high.
250
475
500
550
500
478
475
250
200
SIDE 1
BACK
200
SIDE 2
FRONT INTERIOR
250
250
200
200
3No 5mm Ø Drain holes
25
BASE FRONT
50
70
50
475
250
Hinge
250
Internal block (optional)
Hole
500
550
475
200
FRONT EXTERIOR
Measurements are in millimetres (mm).
Timber thickness 25mm.


Nest Box Materials
& Key Design Features
By Alice McGlashan
Facebook: https://www.facebook.com/groups/nestboxes/
Expanded info: www.gosthorstales.com/nest-box-materials/
Hinged lid at rear of nest box
- Stainless steel hinge
- Brass hinge
Or
Screw lid on with stainless steel or galvanised screws.
Sloped lid for quick rain runoff
Overhanging lid to shelter entrance from rain
Tree attachment mechanism, several options.
See Nest Box Materials document
www.nestboxtales/nest-box-materials
Good nest box construction materials:
- Hardwood timber (15mm + thick)
- Marine ply (15mm + thick)
- Exterior ply (15mm + thick)
- Untreated pine (15mm + thick)
Nest box access – internal and external climbing ladder:
- Parallel saw or chisel cuts in timber
- Screwed in long, thin pieces of timber
Optional addition for larger possum boxes only:
- Stick added outside beneath entrance
Note: the stick may fall off. Install this in addition to the climbing ladder.
Installation Height:
- 4.5-5m
Installation Aspect:
- On S-SE side of tree
Screws:
- Galvanised
- Stainless steel
Add drainage holes:
- Four holes, one in each corner
Paint nest box exterior:
- Protects for 10-20 years
- Water-based (non-toxic)
- Exterior/outdoor grade
- 2+ coats
Oil nest box exterior:
- Protects for 1-4 years
- Non-toxic (e.g. linseed)
Bedding, 1-2 inches deep of:
- Wood shavings
- Untreated fine chipped wood or bark
Ratio of nest box sizes to make:
10:1
(small + medium) : (large)
Many small and medium sizes
Few large sizes
Entrance hole size matters why?
- Just-right for species, excludes predators and competitors
Small entrance sizes:
- 25mm, 30mm, 40mm, 50mm
Medium entrance sizes:
- 60mm, 65mm, 70mm, 75mm, 80mm, 85mm, 90mm
Large entrance sizes:
- 100mm +

Appendix vi

HOLLOWHOG

What is a Hollowhog?

The Hollowhog is a unique wood carving tool that has been specifically designed to create habitat for hollow dependent wildlife. Through extensive trialling in New South Wales, this Australian designed and manufactured tool has proven its ability to safely and quickly carve hollows in the toughest hardwoods.

What problems does the Hollowhog solve?

The loss of tree hollows throughout the landscape is well documented both here in Australia and in many other parts of the world. Hollows provide homes for at least 300 Australian vertebrate species and more than 1000 species worldwide are know to depend on them for nesting and roosting.

For many years dedicated individuals and organisations have been addressing this loss of hollows through the installation of nest boxes. More recently, trials of chainsaw carved hollows have been promoted as a solution for fauna that won't readily use nest boxes.

Internationally, other methods have been trialled to speed up the formation of natural tree hollows. Methods have included tree wounding and inoculation with fungi; a technique called coronet cutting in Europe that promotes the development of heartwood rot; and even the use of explosives to remove tree crowns in North America.

All of these solutions have inherent problems – whether ongoing maintenance and failure of nest boxes, excessive damage to living trees or long timeframes until hollows form.

Extensive research has shown that hollow dependent fauna have preferences for certain hollow characteristics – whether they are a natural tree hollow or artificial nest box. The main drivers for use of one hollow over another are thought to be:

- Hollow entrance size – many fauna prefer to squeeze through the smallest entry possible
- Thermal properties – tree hollows have been demonstrated to remain cooler on hot days and warmer on cool ones than thin-walled nest boxes. For some fauna this attribute is critical for their ability to survive in harsh conditions.
- Hollow cavity size – the internal cavity of a hollow needs to be large enough to accommodate either a single animal or multiple adults and their growing offspring.

The Hollowhog provides a new approach that solves each of the above issues and efficiently creates a large cavity through a small hole in a short space of time.

Carve living space for life

Hollowhog's design

The Hollowhog was specifically designed and tested with the following principals in mind. It had to be:

- Easy to use
- Safe to operate
- Durable and modular so that parts could be replaced as needed
- Able to be attached to readily available equipment
- Able to hollow out and carve in soft and hard wood with the minimum of effort and in the shortest possible time
- Able create a large cavity through a small hole with minimal damage to the living parts of a tree
- Able to solve a wide range of conservation issues
- Be usable by any capable and competent person

What can a Hollowhog do?

The Hollowhog efficiently and safely creates large internal cavities through small entry holes in both living and dead wood. No other damage to the tree's cambium (living tissue) occurs through the carving process meaning that there is little disruption to a tree's growth.

The Hollowhog creates a 50 mm entry hole and then progressively carves a larger and larger hollow of any dimensions up to about 600mm wide and long by 600mm deep. The hollow shape can be easily adapted to the size and shape of the tree limb or trunk that it is being carved in.

As an example, this 300mm long by 200 mm wide by 350 mm deep hollow was carved through a 50 mm entry hole in less than half an hour.

The entry hole size and shape can be targeted to any fauna species through either carving a larger entry hole or adding entry modifiers to reduce the size back down to as small as needed. There are many reports of larger more aggressive species displacing smaller hollow occupants where a hollows entrance is big enough for them to get in.

Carve living space for life

For small entry holes, to ensure that the tree does not close it over in the first few growing season, and to provide weather protection on vertical trunks, the installation of an entry modifier can be a real benefit. The tree will readily lock in the attached modifier after about a year's growth.

There are many variations to the size and shapes of hollows that can be achieved using the Hollowhog. The tool is just as efficient at making salvaged log hollows and habitat for ground dwelling fauna.

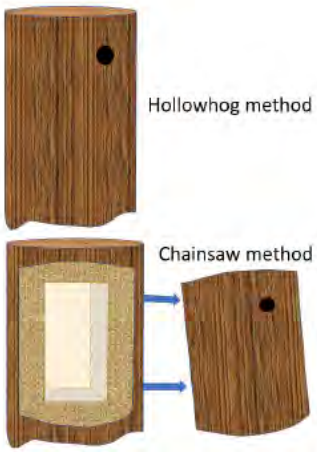
Carve living space for life

Is it safe to be carving into trees?

This is by far the trickiest question to answer, but, as has been demonstrated over the past few years through the carving of hollows with chainsaws, if certain precautions are taken it can be made a safe process. The best advice will always be to seek professional advice from an arborist about what volume of the trunk or limb can be safely removed without compromising a tree's structural stability. Research has been done in this area and arborists who have been installing chainsaw carved hollows generally stick to the rule of thumb that a maximum of 30% of a limb or trunk's diameter can be removed when centrally placed. As an example, this equates to a hollow with a diameter of about 200mm in a 600mm diameter tree. There are many trees that continue to live for decades with far less than 70 % of their trunk diameter remaining, but as hollow carving is a relatively recent development, err on the side of caution and always consult with a knowledgeable arborist for advice. There are now many arborists around Australia who have been installing chainsaw carved hollows.

Why not just use a chainsaw?

Chainsaw hollow carving has been happening now for the past few years and the hollows produced have been demonstrated to be used by fauna. The process though requires that a face plate, that is longer and wider than the hollow, is cut off the tree to allow for hollow excavation to occur. In general, this means removal of anywhere up to a 500mm wide by 600 mm long plate of the tree's living tissue for an average sized hollow. This plate is then glued and screwed back into place and a small entry hole cut for access, but the whole plate is now effectively dead wood. It can take many years for the plate to grow over in living trees, leaving it prone to splitting and cracking, rot, fire and termite attack. The good news is that trees do appear to continue to grow following chainsaw hollow carving.



By comparison, for an average sized hollow, the Hollowhog method leaves just the small 50mm entry hole and an intact surrounding living cambium. This means that it can be used in smaller diameter limbs than chainsaws including directly into the end of branch stubs and in any direction whether vertically up, down or anywhere in between. Arborists have been particularly keen on the Hollowhog's safety aspects. There are no spinning parts outside the hollow entry after about 30 seconds of carving.

The Hollowhog also provides the ability to tap into existing natural voids in a tree. Many Eucalypts have central pipes that have no entry point. The Hollowhog can be used to form the entry point and carve out a space around the pipe to suit.

Where can I get a Hollowhog?

For information on how to get a Hollowhog please contact:

Matt Stephens

0418 295 365

or

Info@hollowhog.com.au

I will be happy to provide a demonstration and training day.

Carve living space for life