Threatened Species Recovery Hub

National **Environmental Science** Programme

Understanding the Spatial Ecology and Habitat Use of Leadbeater's Possum in Regrowth Forests

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Cover image: Leadbeater's Possum (Gymnobelideus leadbeateri) (Photo: T. Bawden)

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Mountain Ash single age class regrowth forest, Maroondah catchment, Victorian Central Highlands. (Photo: D. Blair)

Mountain Ash forest of mixed age, with large old trees and midstorey shrubs and trees, Toolangi, Victorian Central Highlands. (Photo: D. Blair)

Abstract

This report covers work to date on the National Environmental Science Program Threatened Species Recovery Hub project *3.3.2 Adaptive management for threatened mammals in Victorian Central Highlands*. The primary objectives of this project are to determine spatial patterns in how the Critically Endangered Leadbeater's Possum (Gymnobelideus leadbeateri) is using different kinds of disturbed and regenerating forest. This report outlines the project design, the steps taken to achieve the project objectives, and the challenges faced to date. The report concludes by outlining the further work required to meet the project objectives.

At the outset of this study, it was determined that new generation, lightweight GPS tracking harnesses would be the best approach to gathering the movement data required to quantify how animals are using areas of post-fire and post-logging regrowth. A new, fit-for-purpose harness design was developed and trialed on captive animals. Some problems were encountered in fitting the harnesses and trials to finesse an appropriate system are ongoing.

In preparation for tracking, extensive trapping was conducted at a series of six sites in the Powelltown Forest District in the Central Highlands of Victoria. The trapping sites targeted areas where animals had been detected on cameras and/or where past stagwatching surveys and nest box studies had recorded Leadbeater's Possum. A total of 5775 trap nights was conducted during 14 weeks in a period between May 2017 and April 2018. No Leadbeater's Possum were trapped. Other species were trapped, including the Sugar Glider and Agile Antechinus, indicating that the trapping system can capture animals active in the understorey and midstorey of the forest (where Leadbeater's Possum often forages).

Further work is planned to complete the trials of harness suitability on captive animals. Following this, GPS tracking devices will be fitted to animals captured from nest boxes in Powelltown and other locations in the montane ash forests of the Central Highlands of Victoria. This will provide important new insights into the spatial ecology of Leadbeater's Possum and have major implications for management strategies designed to better conserve the species.

1. Introduction

Leadbeater's Possum (LBP) is a Critically Endangered species of arboreal marsupial that is endemic to the State of Victoria [1,2]. The species is one of the best studied threatened species worldwide [3] and extensive data have been gathered on its distribution, habitat and denning requirements, and diet [4]. Despite extensive past research and monitoring, several key knowledge gaps remain. For example, while it has been well known for more than 35 years that LBP can inhabit early successional forests which support an array of large old trees (see [5]), current understanding is limited about how the species uses (and moves through) such areas of young forest. This is an important gap in knowledge that urgently needs to be closed because ~98% of the Mountain Ash forest estate (which forms the vast bulk of the known distribution of LBP) is 80 years or younger [2,6].

This report outlines new work that aims to enhance understanding of the spatial ecology of LBP. That work is motivated by a series of key, inter-related questions. These are:

- How far do LBP travel each night from their den tree? This includes during foraging, territory marking, den tree use, and nest maintenance.
- What is the pattern of the habitat use? Do animals follow linear features or move more broadly across the landscape?
- Do animals move continuously throughout the night or return repeatedly to a den tree?
- How many den trees does an individual LBP use in regrowth forests, and what is the spatial pattern (including the inter-tree distance) of these trees?
- Is there a threshold for the number of hollow-bearing trees required to ensure the occurrence of LBP at a site?
- What is the decay status or form of the den trees used by LBP in regrowth forest?

A better understanding of the spatial ecology of LBP is critical not only for increasing knowledge about the suitability (or otherwise) of the kinds of forests which now dominate most of the montane ash forests of the Central Highlands of Victoria, but also for developing enhanced prescriptions for logging operations that better integrate wildlife conservation and timber and pulpwood production.

This report is structured as a series of inter-related sections. The first section contains a summary of the biology and ecology of LBP. The second is an outline on the sequence of steps that aimed to commence tracking the species. The third section highlights some of the key results of intensive trapping and harness design. The concluding section focuses on some of the challenges of this project and also makes recommendations for future work.

2. Background

Leadbeater's Possum (*Gymnobelideus leadbeateri*) (LBP) is a Critically Endangered arboreal marsupial. Most populations live in a small geographic area (60 x 80 km) in the Victorian Central Highlands [4] (see Figure 1). The core range of the species is within the Mountain Ash and Alpine Ash forests, north-east of Melbourne. Populations also occur in sub alpine Snow Gum at Lake Mountain and lowland Swamp Gum in the Yellingbo Conservation Reserve.

Adult LBP weigh 100-160 grams, and measure 150-170 mm in length. The species has a club-shaped tail that is uses for balance as it moves rapidly through dense vegetation. Colonies of up to 12 LBP nest in large old trees, where they build a nest of shredded woven bark [7]. Animals forage in the midstorey of Acacia and in the trunks and canopies of eucalypts, feeding on insects and plant exudates [8].

LBP was thought to be extinct until it was rediscovered at Tommy's Bend near Marysville, Victoria in 1961 [7]. In the 1980s, researchers began examining the habitat, diet and general ecology of the species. These initial studies used trapping, stagwatching, VHF radio-tracking, and spotlighting to gain insights into the ecology of the species [5,7,9-12].

LBP can be a difficult animal to study. Trapping effort can be high for small number of captures [12]. Detailed trapping studies of LBP have been conducted at Cambarville, ~ 15 km east of Marysville in the Central Highlands of Victoria. Ladders were attached to trees to provide better access to the animal's movement pathways for trapping [9,12] and large towers were constructed to try and improve the accuracy of the radio-tracking signals [11]. Intensive trapping at Cambarville between 1990 and 1991 entailed 6650 trap nights using Elliot traps mounted on trap brackets located 4-10 metres above the ground (see [13]). A total of 35 captures was made (including recaptures). Some of these captured animals were radio-collared and then tracked to daytime den sites in large old hollow-bearing trees [11]. Similarly, a small number of animals were captured at the 11 sites subject to intensive trapping surveys between 1983 and 1984 [5,12].

Several papers published during this period in the 1990s have guided much of the management of LBP to the present day. These papers were based on the studies of LBP colonies in high quality habitat at Cambarville and elsewhere. Research into LBP in Mountain Ash forests since this early work at Cambarville has been based primarily on stagwatching surveys [14]. Most of these studies have entailed nocturnal surveys at long-term monitoring sites established by the ANU. There is also allied work on the decay and collapse of hollow bearing trees (which are the sole nesting and denning sites for LBP) at these same sites [15] (see Figure 2 for an illustration of trees forms). This information generated from the long-term sites is the only time series data available on LBP.

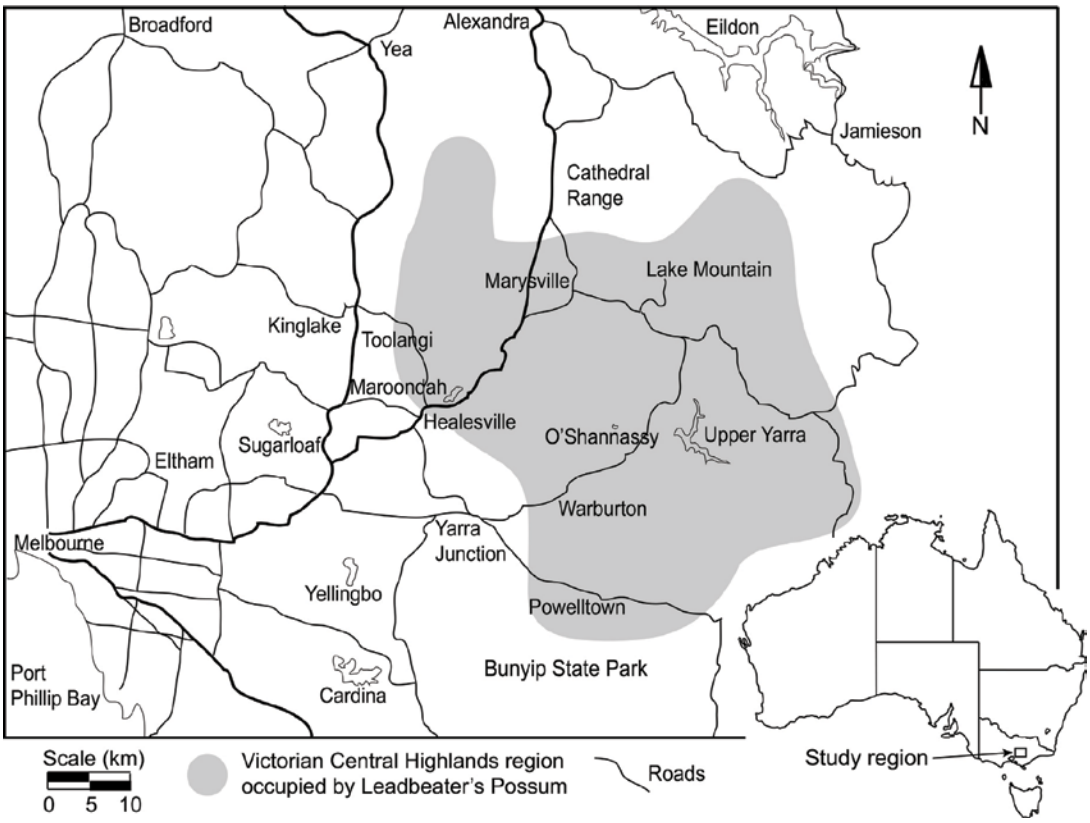

Figure 1: Map showing area occupied by Leadbeater's Possum in the Victorian Central Highlands.

The core focus of this report is the Central Highlands montane ash forests. Other work has been undertaken in Snow Gum and Swamp Gum communities at Yellingbo and Lake Mountain, primarily focussing on nest box use by LBP, but those areas are not the subject of this report.

Other recent studies on LBP in the Central Highlands ash-type forests have examined:

- The use of rope bridges by LBP. This was part of an impact assessment of fuel breaks installed in 2010 (ARCUE).
- Remote camera trapping surveys (Arthur Rylah institute (ARI)).
- Call playback surveys (ARI).
- Nest box installation and monitoring (ANU).
- Nest box installation and monitoring (Parks Victoria).
- Identifying new habitat outside LBP's known range (University of Melbourne).
- Thermal properties of nest boxes (University of Melbourne).

Since the initial work in high quality habitat at Cambarville, there has been no further research on how individuals move through the landscape. As ash forest landscapes have been dramatically modified by logging and fire in the past two decades [4], how LBP uses regrowth forests specifically, remains a major knowledge gap.

2.1. Habitat requirements

In montane ash forests, the habitat requirements of LBP includes large old hollow-bearing trees and dense midstorey vegetation dominated by Acacia spp. trees [10]. Mountain Ash (Eucalyptus regnans) trees take over 120 years to begin developing hollows [16]. Currently, approximately 98% of the known range of LBP is less than 80 years old (given that stands dating from past fires such as those in 1905, 1908, 1926 and 1932 are rare). The different characteristics of Mountain Ash trees, and a classification of their forms, are shown at Figure 2.

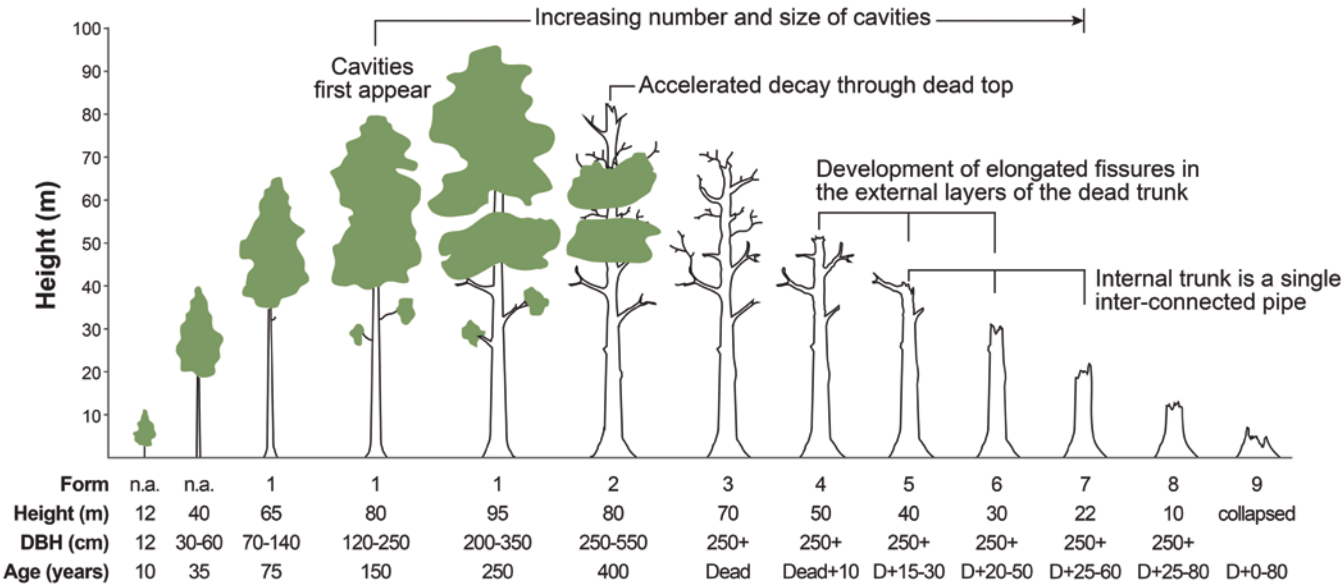

Figure 2: Forms and characteristics of Mountain Ash trees.

High severity fire in old growth Mountain Ash can kill many adult trees and create a dense midstorey. These large dead hollow-bearing trees can remain standing for over 80 years, whereas smaller diameter dead trees collapse more rapidly [17].

As the dead Mountain Ash trees begin to decay following fire, the internal structure of the tree begins to rot, and fissures and cracks form in the hard outer layers [18]. LBP chew small keyhole entrances in these fissures and build large nests of woven bark within the tree trunk [7]. As these trees continue to rot and decay, the structure and function of the tree may not remain suitable for LBP occupation [19]. The loss of these large old trees across the landscape is the major threat to the future persistence of LBP [15]. Modelling of ANU long-term monitoring plots shows that by 2065, half of the 192 plots will have no hollow bearing trees [20].

Areas of old forest that burnt on Ash Wednesday in 1983 have been a hot spot for LBP until recently (2018, unpublished ANU surveys). Each of the 5 ANU monitoring sites in 1983 regrowth has had LBP present until more recent surveys. The large old trees on these sites have undergone significant decay and collapse, two of the monitoring sites have no remaining hollow-bearing trees and only one of the five sites has supported LBP in recent surveys.

The ANU monitoring plots in 1983 regrowth will not have any hollow-bearing trees for another ~ 100 years [21]. Furthermore, fire in forests of this age class of forest will consume the remaining large dead trees, leaving large patches of regenerating forest without hollow-bearing trees [6]. Burnt old forest that has then regenerated after fire is rare in montane ash landscapes. Young forest that burns and regenerates does not have the critical elements that characterize older burned forest, primarily large old, fire-damaged trees [22]. Young trees with a small diameter do not remain standing for as long as large diameter (and hence older) trees [23]. The creation and loss of these critical large old trees is a well-studied process [6,18,20,23]. The use of these trees by LBP on ANU sites is also well quantified [11,21,24,25].

2.2. Key knowledge gaps

Current understanding of spatial movement patterns by LBP throughout the forest is based on data limited to day time radio-tracking of individuals to their den trees [11,25]. Some unpublished work has followed VHF collared animals at night at Yellingbo Nature Reserve using grid based locations. Generating accurate spatial movement estimates from such work has proved to be problematic (D. Harley, personal communication). This is because animals are flushed ahead of a researcher and tracking efforts yield limited position accuracy of collared individuals (D. Harley, personal communication). Yellingbo Nature Reserve is a narrow Swamp Gum (*Eucalyptus ovata*) floodplain surrounded by cleared agricultural land, so comparisons of spatial movements with those of animals in the Central Highlands Mountain Ash forests may be problematic.

Based on radio-tracking to den trees during the day, LBP were found to use several hollow-bearing trees in a given area [11]. Current prescriptions for managing LBP in State Forest focus on historical home range data [4]. However, the area of forest surrounding known den trees which needs to be protected to effectively conserve LBP is unknown [4]. Home range shape is also unknown, as is the use of landscape features like slopes, gullies and roadsides. Indeed, the foraging distances travelled at night by LBP are poorly understood in all of the environments where the species has been found. For example:

- During stagwatching at long-term ANU sites, LBP have been observed to emerge from den trees and move rapidly off-site and into the surrounding forest. It is rare for animals to remain within the 100 m x 100 m monitoring site for the duration of the 1 hour stagwatch.
- ARI surveys initially used call play back to survey for LBP presence, but the distances LBP travelled to reach the researchers was unknown. Testing showed the call play back was audible to researchers from a distance of 400 m. The duration of call play back surveys was 1.5 hours, which means animals may have travelled considerable distances to reach researchers.
- Camera traps also provide presence-only data, and distances from den trees to camera points are not known.
- Some records from Yellingbo show some large dispersal movements of up to 1400 m, and movement between den trees of 165 m [26].

The lack of data on LBP movements has meant that management of the species has revolved around the protection of denning habitat. If more than ten trees are found in a 3 hectare area, it is protected from logging (termed Zone 1a under Forest Management planning). If the basal area of Acacia is 5 m2/ha and there are more than 12 live or dead hollow trees in a 3 ha area (termed Zone 1b), the area is protected from logging. Recently, protection of known locations of individual LBP sighted in a forest has initiated the protection of a 200 m area of forest around the location record, on the assumption that LBP do not move far outside of their 3 ha home range [27].

Research following the 2009 Black Saturday fires examined fire refugia and found that areas of unburnt forest needed to be 12 ha or more to contain LBP following the fire [28]. This is much larger than the 3 ha areas protected under current prescriptions, and far greater than the 100 m buffer around known sightings in proposed logging coupes [4].

Understanding how far LBP colonies travel through forest of different ages is vital for ensuring the development of effective management prescriptions for the species. This is especially important in regrowth forest which is targeted for timber harvesting and in areas that contain the increasingly scarce resources on which LBP depend (e.g. hollow-bearing trees).

Whether management prescriptions are maintaining the integrity of habitat surrounding a given colony is unknown. If this could be better understood, LBP persistence at a given location may be increased through improved retention of the necessary area of habitat, connectivity to intact forest and targeted protection of habitat features.

3. Project outline

To date, tracking studies of LBP have focussed on areas of older Mountain Ash forest, and Yellingbo Conservation Reserve. The Mountain Ash sites where radio-tracking was undertaken in the past were a mixture of old growth and 1939 regrowth interspersed with rainforest elements along creek lines [9]. Cambarville is a well-studied location with LBP colonies known to occur there since the 1960s. No tracking work has been completed in regrowth forest.

As there is now just 1.16% old growth Mountain Ash forest left across the Mountains Ash forest estate of the Central Highlands [6], younger regrowth forest is the dominant age class within the known LBP distribution [4]. As outlined above, understanding LBP movement in regrowth forests is currently the largest knowledge gap in understanding the ecology of LBP.

Historically, the approach used to track LBP has been VHF technology. This involves a waterproof VHF transmitter mounted to a leather collar, pulsing at a given frequency. This pulse is read by a researcher using a receiver and antenna (Figure 3). The signal direction and distance is determined by judging the strength of the pulse through the receiver. Physical VHF radio-tracking of LBP when an animal is active at night, particularly in dense, wet Mountain Ash forests, can be extremely difficult. This is because observer movement is likely to flush animals, giving misleading information about animal movements. The VHF signal is also difficult to follow, as the signal bounces off dense vegetation and undulating topography.

GPS technology has been getting smaller and lighter over time. New micro-GPS tags can be waterproof and the same weight as older VHF technology. The GPS technology locates the tagged animal hundreds of times during its nocturnal activities. The GPS tag records and stores locations until an animal is recaptured and the data are downloaded. This provides natural movement behaviour without an individual being disturbed by researchers physically tracking individuals. GPS units can be recharged and redeployed, allowing ongoing tracking in a range of areas.

The size of the technology restricts the power of the GPS receiver, which influences the accuracy of the locations recorded by the device. This is particularly evident in steep gullies and dense vegetation, which are common in the Mountain Ash ecosystems. Testing has shown that location information is accurate to 22 m on average (L. McBurney, unpublished data). This provides confidence that GPS locations will provide a detailed picture of foraging ranges and distances moved by LBP, thereby providing new data that was previously missing about the behaviour of LBP.

Figure 3: Radio-tracking using VHF receiver and antenna, in the Mountain Ash forest.

3.1. A unique harness design for GPS tracking

In past radio-tracking studies, a small leather collar has been used for the attachment of the VHF transmitters [25]. The use of a collar attachment is not possible with the GPS technology, as the circuit board containing the electronics is not flexible enough to fit the circumference of the neck of LBP (between 8 and 10cm; see Figure 4). Additionally, the GPS board is 3.5cm long, and needs to run along the dorsal surface of the possum so that the GPS antenna points skywards, for accuracy of the signal. A weight on a collar has a pendulum effect, bringing the unit under the animal's chin. This would have been bulky under the chin, but also reduce the accuracy of the GPS positions as the antenna would be pointing at the ground. To prevent the GPS circuitboard from moving, several back-pack style harnesses were designed as potential attachment methods.

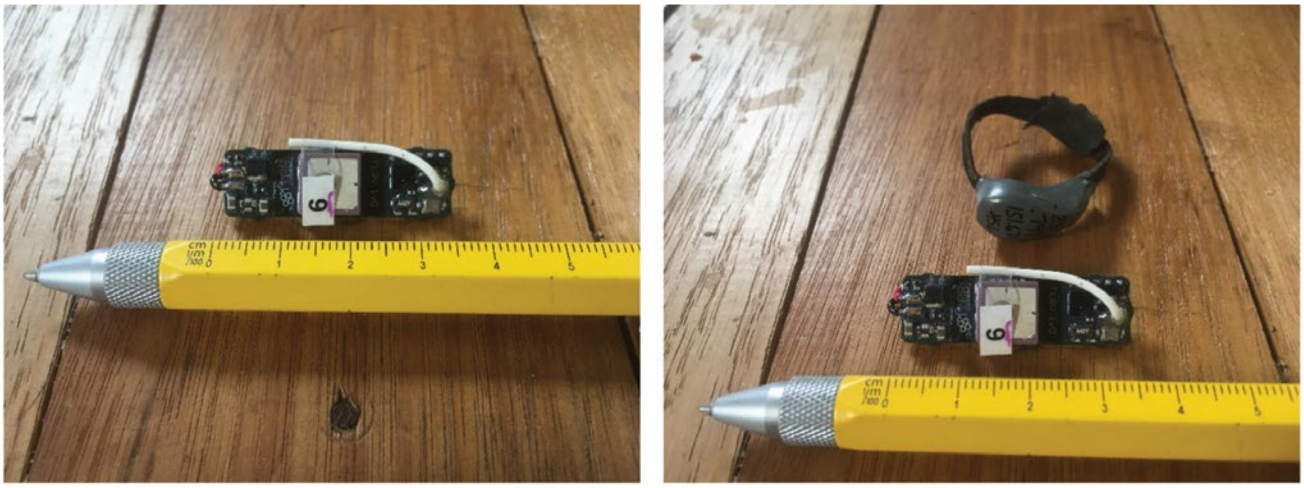

Figure 4: (L) GPS unit circuit board. Electronics cannot be sufficiently flexible to the tight circumference needed to fit around an LBP neck. (R) On the right, comparison of GPS unit and VHF collar showing tight neck circumference.

Two initial designs involved a neoprene harness with the GPS unit inserted into a neoprene pocket on the dorsal surface. The harness straps were secured with neoprene glue. The neoprene harnesses were lightweight and flexible, and designed to spread the weight of the unit and keep the tiny GPS antenna facing skywards. The design was based on an "off-the-shelf" harness design used on small animals like hamsters and ferrets. An early version of this harness is shown in Figure 5.

Figure 5: Initial neoprene harness design. One strap fits around the neck of the possum, the second wraps around behind the front legs, securing the unit to the animal's back.

Figure 6: Final harness design, with no neoprene straps. Both straps are made of leather and use a method of attachment that is known to work for conventional radio collars.

Over the course of the project, the harness design was refined to reduce weight and make the straps easier to secure. The first important modification was to the neoprene harness, where a leather strap replaced the neoprene strap of the initial design. The leather strap attachment is Dr Dan Harley's conventional method for attaching VHF transmitters to LBP. Dr Harley (Zoos Victoria, based at Healesville Sanctuary) has many years of experience using this method in the field at Yellingbo Conservation Reserve. By anchoring the GPS harness to animals by using a conventional leather attachment, their ability to squeeze out of a harness was removed. Section 6.2 (below) describes the trial fitting of this harness and the reason for the need to further modify this design.

The next significant modification of the design involved abandoning neoprene and instead using a leather collar strap for around the neck, and a second leather strap behind the front limbs. The leather strap attachments were substituted for neoprene, as they are a tried and tested method of attaching tracking devices to animals (Dr Dan Harley, personal communication). The final design is shown at Figure 6.

The GPS units were purchased as un-waterproofed units with the batteries separate from the unit. This allowed custom soldering and arrangement of the battery and electronics. It also allowed the shape and structure of the unit to be custom designed when waterproofing the completed unit with epoxy resin.

The weight of the final harness, when loaded with the GPS unit, was 8.2 grams. An adult male LBP can be >120g in weight, so the loaded harness is <10% of that bodyweight. In LBP studies in the past [11] and studies of other species, the accepted protocol has been that the collars are less than 10% of the bodyweight of the animal, and preferably an even lower percentage (see Table 1).

The initial animal ethics permit for this project was for harness fitting in the wild, immediately post capture followed by a wild release. This is the conventional method used when fitting VHF collars on LBP. On 14 November 2016, a trial of the first harness design was conducted on a captive LBP at Healesville Sanctuary to assess how easy it would be to attach the harness in the wild (see Figure 5). The harness was attached by an experienced handler to an animal in a handling bag. Harness fitting proved to be difficult. It was deemed to be too difficult to ensure a secure fit of the harness on an animal in the hand. LBP exhibit a reflex action when handled and curl into a tight ball. To ensure the neoprene harness straps fit securely and neatly to the neck and chest of animals, it was decided fitting would be best done with them under sedation.

Therefore, an amendment was sought to the original animal ethics approval to permit the transport of animals captured in young (<20 year old) regrowth forests to Healesville Sanctuary and sedation of animals for harness fitting by veterinary staff. The animals would then be released at the trapping site at dusk on the same day. The amendment application was submitted on 23 March 2016 and given final approval on 2 June 2016.

Table 1. Selection of studies where arboreal mammals have carried radio tags of comparable percentage body weight to that proposed in this study.

Species	Adult Body weight (g)	Radio tag weight (g)	Radio tag as % body weight	Reference
Sugar Glider (Petaurus breviceps)	120	8	6.7	[29]
Spectral Tarsier (Tarsius spectrum)	110-120	3.5 g & 7 g	3.07 – 7.61	[30]
Dian's Tarsier (Tarsius dianae)	110	11.5	10.4	[31]
Grey Mouse Lemur (Microcebus murinus)	46	3	6.5	[32]
Least Chipmunk *(Tamias minimus)*	*44*	*3*	*6.8*	*[33]*

4. Trapping Leadbeater's Possum in the wild

4.1. Site identification

Initial selection of trappng sites was based on Arthur Rylah Institute's (ARI) camera trapping sites. ARI's camera trapping data included three sites in the Powelltown region of the Central Highlands that met the criteria for trapping sites for this project. These three sites were characterized by:

- Several LBP detections on remote cameras over a survey period of weeks.
- Few or no hollow trees within the ARI habitat survey area (1 ha).
- Regrowth forest age class of less than 20 years.

Powelltown was selected because the region supports a mix of regrowth and old growth forest, has known records of LBP within the broader forest matrix (reserves, regrowth, old growth, nest boxes etc.) and is close to Healesville Sanctuary. In addition, ANU has a long (> 25 year) history of monitoring in the area, and has a number of long-term monitoring sites in the region.

Each potential trapping site was visited 2 or 3 times prior to selection. The site was surveyed for features that are preferred by LBP in younger regrowth areas. Featured looked for included hollow-bearing trees, vegetation connecting to the surrounding regrowth forest, and the presence of *Acacia* and *Leptospermum* thickets, sub canopy dead hollow-bearing trees, and appropriate horizontal structures (fallen trees, branches, logs etc.). Trapping lines were planned based on combinations of these features, plus the presence of topographical features such gullies and slopes. Background research about the sites included consultation with local Department of Environment, Land, Water and Planning (DELWP) staff, and examination of GIS layers of historical logging and satellite imagery. The latter were an important resource for understanding the landscape context and site history for each particular area.

4.2. Trapping methods

Establishing each trapping site took at least five days. Site access was via a track cut through up to 300 metres of forest. Extension ladders, traps, bait mix, brackets, nails, hammers, nails, drills, saws, canvas, flagging tape, spray bottles, wool insulation, ropes and straps was carried into the trapping sites.

Elliot traps and cage traps were placed around a site at varying heights above 2 m. The maximum height for traps was a combination of the optimum vegetation connectivity and the maximum height of the extension ladder (10 m). Past results from trapping LBP in similar habitat showed no difference in trap success between heights of 1.5 m and 10 m (ARCUE researchers, personal communication).

Elliot traps and cage traps were attached to trees in a combination of ways. Some were strapped to branches and tree trunks and wrapped in canvas for waterproofing. Others were mounted on custom-made hardwood boxes and screwed to brackets (see Figure 7), and attached to *Acacia* and eucalypt trees. Traps were placed along horizontal structures and runways where LBP could move easily (see Figure 8).

Figure 7: Hardwood boxes on brackets. Designed as a "sleeve" to house aluminium Elliot traps. They also waterproof and insulate traps. These were placed at heights of 1.5m to 12m above the ground. These remain permanently in the field allowing resident LBP to become familiar with the infrastructure and associated creamed-honey baits.

Figure 8: An Elliot trap set in the hardwood sleeve. These give researchers access to locations on tree trunks. Traps were set within LBP jumping distance of other vegetation.

A range of baits was used across the trapping sites. These included small mammal bait (creamed honey and oats), creamed honey in an open container, powdered egg mixed with small mammal bait.

These baits have been used successfully in previous capture efforts for LBP trapping (Zoos Victoria and ARCUE, personal communication). Notably, adding peanut butter increased the rate of by-catch of the Agile Antechinus and the Bush Rat. A solution of honey dissolved in water was sprayed up and down the tree on which each trap was located.

Initially, two sites were established close to Powelltown. Traps were baited and wired open and hardwood boxes were erected and smeared with honey and baits. These were left open for two weeks to allow animals to become familiar with traps (as per the methods employed by ARCUE in 2011, Lee Harrison personal communication). Each trapping point was sprayed with a honey/water solution in the branches and up and down the trunk, and resprayed each day throughout the duration of the trapping.

Four motion detection camera traps were placed at each of the two sites. These cameras were checked after three weeks and three LBP images were obtained. LBP were therefore present, but in low numbers. The camera images showed that animals investigated traps but did not enter them (Figures 9 and 10).

Figure 9: LBP on site and near trap (cage trap at the top of the image). The cameras were not triggered for more than 1-2 pictures, showing LBP did not enter the traps or remain near the traps for long.

Figure 10: LBP club shaped tail at top of image on an Acacia tree trunk. This animal was not seen investigating the bait.

4.3. Trapping sites #1 and #2

Trapping sessions were planned more than two weeks in advance to fit with the schedules of the Healesville Sanctuary veterinary staff. The first trapping session involved placing 25 Elliot and 5 cage traps at each site two sites (1 and 2: See Figures 11 and 12). Traps were set in the afternoon and checked from dawn the following day, for one week. In the first week, 7 of the 50 Elliot traps had been disabled by animals forcing open the rear door. Heavy duty duct tape was added to Elliot traps from this time, which solved the problem.

During this trapping week, no LBP were caught (see Table 2). Similar results were obtained during the second week trapping at these two sites (Table 3).

Figure 11: Site 1 Trapping lines shown in red. Trap lines were placed up a slope and along the road, targeting sub canopy dead stag trees and connectivity. Bottom left is the township of Powelltown. The dense Mountain Ash and Acacia regrowth can be seen as shades of light green and dark green around the red line of the transect. The only sub-canopy dead stags found near to the initial LBP sightings were targeted for trapping.

Figure 12: Site 2 Trapping lines shown in red. These traps targeted roadside vegetation and large old live trees. Behind the site is young regrowth. North of the trapping site is an ANU monitoring plot with LBP present along roadside.

Table 2: Trapping results for sites 1 and 2: Week 1

150 trap nights at each site from 29 May to 5 June 2017
30 traps at each site
Total trap nights = 300

	Antechinus agilis	Rattus fuscipes	Possums / gliders	Leadbeater's Possum
Site 1	6	1	1	0
Site 2	5	2	1	0

Table 3: Trapping results for sites 1 and 2: Week 2

150 trap nights at each site from 12 June to 16 June 2017
30 traps at each site
Total trap nights = 300

	Antechinus agilis	Rattus fuscipes	Possums / gliders	Leadbeater's Possum
Site 1	5	0	2	0
Site 2	3	1	3	0

After two weeks of unsuccessful trapping at Sites 1 and 2, another 20 traps were added to each site to increase the trapping effort and broaden the area targeted for trapping. Elliot traps also were placed on the ground underneath each of the mounted traps to reduce the bycatch of small mammals by capturing them at ground level before they could climb to the higher traps. Each site had a total of 50 traps. For comparison, trapping at Yellingbo Conservation Reserve for LBP never exceeds more than 20 traps (D. Harley, personal communication). The additional two weeks trapping at these first two field sites also yielded no captures of LBP (Table 4).

Table 4: Trapping results for sites 1 and 2: Weeks 3 and 4

250 trap nights at each site from 19 June to 23 June 2017
250 trap nights at each site from 10 July to 14 July 2017
50 traps at each site
Total trap nights = 1000

	Antechinus agilis	Rattus fuscipes	Possums / gliders	Leadbeater's Possum
Site 1	13	10	15	0
Site 2	21	10	11	0

Thus, over the course of four weeks of trapping at two sites, totalling 1600 trap nights, no LBP were captured.

Both Site 1 and 2 were surveyed by spotlighting on two occasions (12 June 2017 and 5 July 2017) and 3 individual LBP were seen, but never multiple animals at the same location. There were five captures of Sugar Gliders at Sites 1 and 2.

The trapping sites supported very few hollow trees within 100m of the trap locations and few animals were detected during spotlighting surveys. To better understand why LBP were not being found, the composition of age classes and other attributes of the landscape surrounding the trapping sites were assessed, using historical photos obtained from the local DELWP offices in Powelltown (Figures 13 and 14). These show some patchy retention of trees in the south west of the area, and older forest north west of the trap locations. The site was harvested between 1997 and 2000 (see Figure 14).

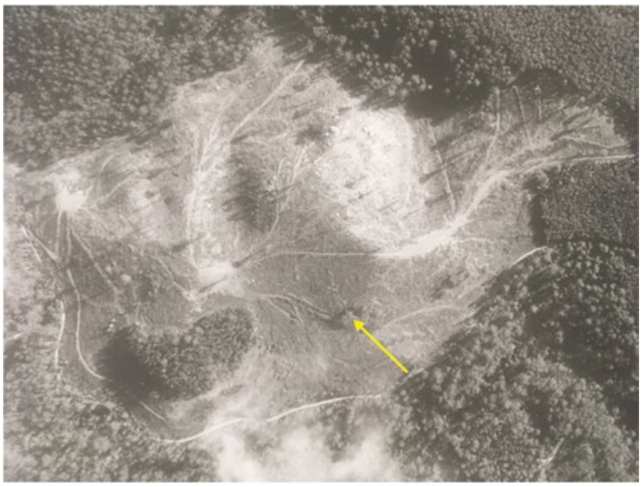

Figure 13: Trapping line marked in yellow over historical logging aerial photo. Patchy tree retention can be seen within the coupe area.

Figure 14: Historical logging aerial photo of trapping Site 1. Each dotted line represents a different year of harvesting. The solid polygon in at the bottom left of the coupe area is an area of retained regrowth. The yellow line is the direction of the trapping line.

LBP were not seen denning in the hollow trees immediately within the trapping site (these were stagwatched). It is unlikely that LBP were denning in the retained regrowth patch shown in the polygon in Figure 14, as this patch was visited several times and no hollow trees were found. Figures 15 and 16 are ground-level views of this patch.

Figure 15: A ground-level view of the retained patch shown in the historical aerial photos at Figures 13 and 14. It is young forest, with no hollows, but supports forest with connectivity in the midstorey. It is the closest area of retained forest to the trapping lines, but does not support potential denning trees.

Figure 16: The view facing 180 degrees from the retained patch shown in Figure 15, looking into the old harvested areas. Simplification of the vegetation and the absence of large trees is evident, yet the structure is dense in the midstorey and regenerating overstorey.

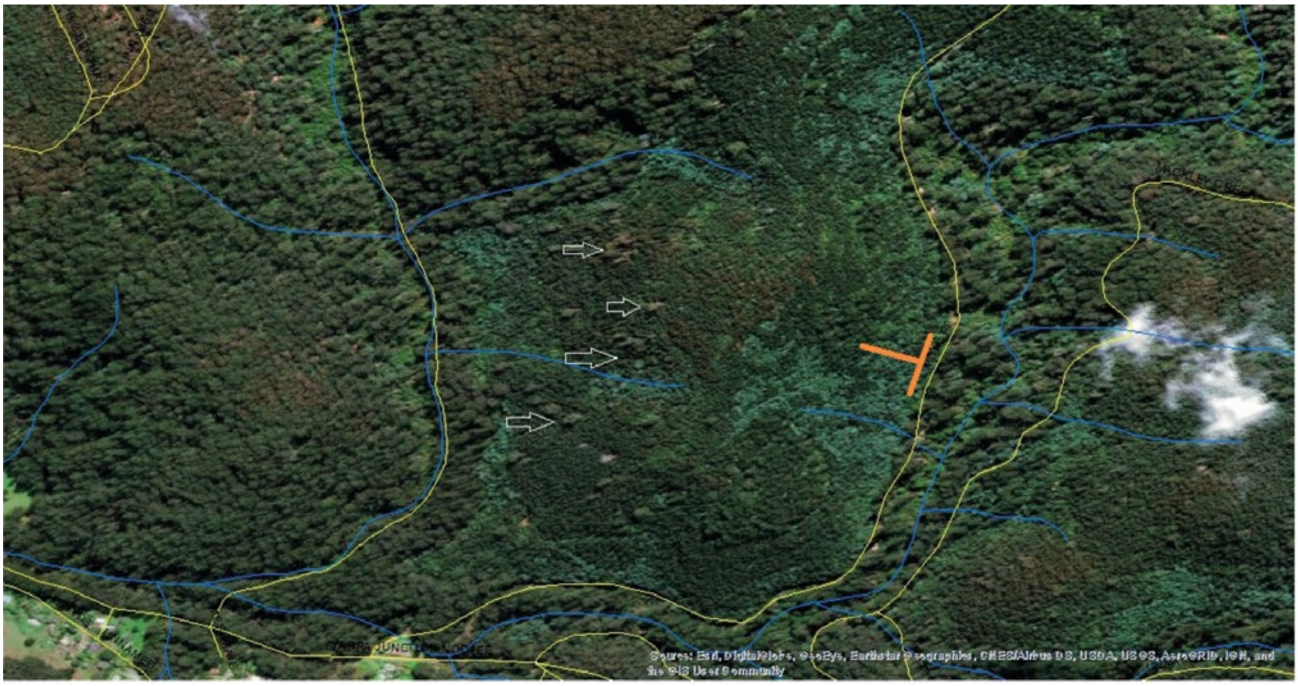

Figure 17: Site 1 landscape context. Red lines show trap lines, yellow lines are roads, blue lines are streams and the white arrows show emergent trees visible through the regrowth. These hollow-bearing trees are well over 400 m from the trapping locations.

Figure 18: Site 3 trap lines are shown in red. There were no hollow-bearing trees within the younger forest surrounding this gully (represented by the dense green). The edges of the gully have eight small diameter dead trees and were of limited height. Three large old living trees occurred further along the gully. An ANU monitoring site is indicated by the purple square.

There were five small hollow trees with a diameter of ~ 1.5m near the trapping lines. The surrounding area had no other hollow trees within 200 m. The retained patch also had no hollow-bearing trees. Reviewing the mapping and historical photos, some emergent live/dead hollow-bearing trees become apparent to the north east of the site 400 m from the trapping lines (as shown in Figure 17). The LBP detected in this area did not nest on site and the nearest suitable habitat was 400 m away.

For these reasons, it was decided to close Site 1 and focus efforts on a new site. The traps were moved to a new site (Site 3). A total of 30 traps was established at the new site. Traps were targeted at different topographic locations within the site. These were along a ridgeline, down a slope and along a gully. Trap locations were targeted at places with connected vegetation and close to hollow-bearing trees (Figure 18). Traps were established over a period of one week. They were then baited and placed (wired open) for two weeks (from 24 July 2017) at Site 3 prior to being set.

The first two weeks trapping (Weeks 5 and 6 of the whole program of trapping) produced no LBP. Some nocturnal surveys and call playback produced only one LBP on one occasion (Tables 5 and 6).

Another 20 traps was added to Site 3. Trapping was undertaken at Site 3 for one more week (Week 7 of the program; Table 7), while Site 2 was pulled in.

No LBP were caught at these first three trapping sites, despite a substantial trapping effort of 2650 trap nights in the period between 29 May and 10 November 2017.

Table 5: Trapping results for Site 2: Weeks 5 and 6

250 trap nights from 24 July to 28 July 2017
250 trap nights from 14 August to 19 August 2017
50 traps
Total trap nights = 500

	Antechinus agilis	Rattus fuscipes	Possums / gliders	Leadbeater's Possum
Site 2	16	5	9	0

Table 6: Trapping results for site 3: Weeks 5 and 6

150 trap nights from 24 July to 28 July 2017
150 trap nights from 14 August to 19 August 2017
30 traps
Total trap nights = 300

	Antechinus agilis	Rattus fuscipes	Possums / gliders	Leadbeater's Possum
Site 3	10	6	2	0

Table 7: Trapping results for Site 3: Week 7

250 trap nights from 6 November to 10 November 2017
50 traps
Total trap nights = 250

	Antechinus agilis	Rattus fuscipes	Possums / gliders	Leadbeater's Possum
Site 3	10	0	2	0

4.4. Additional trapping sites in regrowth forest

A new approach was needed to improve trapping success. Rather than utilizing ARI camera trapping records, regrowth sites were selected where there had been known LBP populations for a prolonged period (at least 5+ years) (see Figure 19).

The new area targeted for trapping, Dowey Spur, supports 1983 regrowth with large old dead hollow-bearing trees and mixed age forest in gullies connected to the regrowth. There is also a part of the LBP reserve system to the north of Dowey Spur. The sites where rope ladders had previously been installed by ARCUE were targeted, as they were also the location of the last successful trapping efforts in the Central Highlands of Victoria (ARCUE, unpublished data).

Site 4 was established along the road at Dowey Spur and around the location of the rope ladders (Figure 20), and 25 traps were installed. Parks Victoria have Project Possum nest boxes adjacent to this site, but no colonies have been recorded as present in the nextboxes. However, there are several dead hollow-bearing trees in the area on both sides of the road, particularly on the southern side of the road where there are eight large dead hollow-bearing within 200 m of the trapping sites.

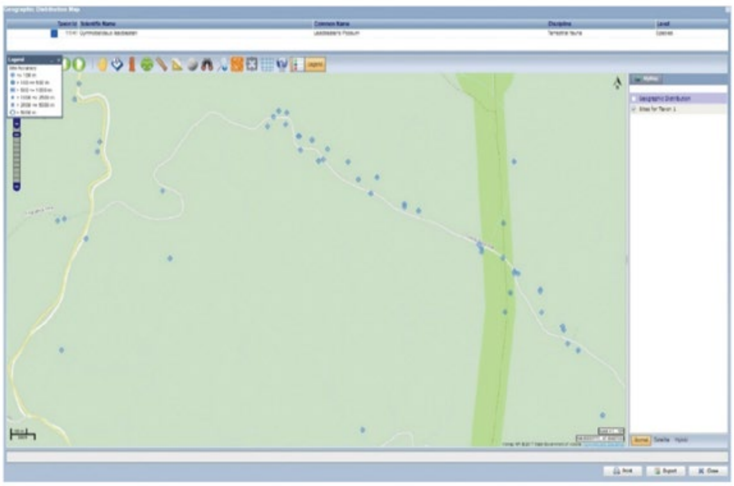

Figure 19: Records of LBP from Dowey Spur near Powelltown have been high since the late 1990s (Source: Vic Bio Atlas).

Figure 20: Site 4 trap lines, marked as red lines. Large dead sub-canopy stags are scattered through the gullies south of the site. Animals were successfully caught at this location in 2012 and rope bridges were thought to increase connectivity across the road. The two ANU monitoring plots (purple squares) have supported LBP in the past, but not since 2015, most likely due to the collapse of large old trees.

A series of trap nights was conducted at Site 3 and Site 4 in early 2018. In preparation, the traps were wired open and baited for several weeks before trapping started. There were no captures of LBP at either site during this trapping period (Tables 8 and 9).

Table 8: Trapping results for site 3: Weeks 8 and 9

250 trap nights from 12 February to 16 February 2018
250 trap night from 26 February to 2 March 2018
50 traps
Total trap nights = 500

	Antechinus agilis	Rattus fuscipes	Possums / gliders	Leadbeater's Possum
Site 3	24	6	9	0

Table 9: Trapping results for site 4: Weeks 8 and 9

125 trap nights from 12 February to 16 February 2018
125 trap night from 26 February to 2 March 2018
25 traps
Total trap nights = 250

	Antechinus agilis	Rattus fuscipes	Possums / gliders	Leadbeater's Possum
Site 3	10	0	0	0

Spotlighting and call playback produced one LBP approximately 50m from the rope bridges, so an additional 10 Elliot traps were established in that area at site 4.

A new site (Site 5) was then established at ANU monitoring Site 107. This site had 12 LBP recorded on it during a formal stagwatching survey in 2015. However, no LBP were detected during the January 2018 stagwatching as part of the ANU long term monitoring program.

In 2017, one of the den trees which had LBP emerge from it in 2015 had collapsed. Since ANU monitoring Site 107 was established in 1997, 10 of the 18 hollow-bearing trees on the site have collapsed. Follow up inspections of this area in March 2018 located five large old living hollow-bearing trees, a dense midstorey, and areas of 1981/82 regrowth forest scattered throughout the site. GIS Imagery (aerial photography, satellite images and land use shapefiles) show the patch of forest is connected to LBP reserve (SPZ) on its southern border, and very young (<10 year old) regrowth on either side of the site (Figure 21).

The site is adjacent to a gully that connects with the same gully system in Site 3 (see Figure 21). The gully system contains patches of *Leptospermum*, cool temperate rainforest, and older forest. The site is characterized by approximately 70-year old regrowth with dead sub canopy hollow-bearing trees. The likely movement pathways for LBP would be from the canopy, into stands of Acacia, and the *Leptospermum* gully at the rear of the site.

Site 5 was focussed on the edge of the gully, where 25 traps were deployed. Trapping was then conducted at Sites 3, 4 and 5 for two weeks (Table 10). No LBP were captured.

Figure 21: Site 5 (ANU monitoring Site 107) is in the purple circle in centre. The gully vegetation (blue) connects it to trapping site 3 (circled in red). Young regrowth is evident in the denser green areas, with the older forest evident as the patchy green surrounding the gullies. The two sites circled both have known records of LBP. The presence of the linking vegetation provided confidence that LBP were onsite.

Table 10: Trapping results for sites 3, 4 and 5: Weeks 10 and 11

550 trap nights from 5 March to 9 March 2018
550 trap nights from 19 March to 23 March 2018
110 traps
Total trap nights = 1100

	Antechinus agilis	Rattus fuscipes	Possums / gliders	Leadbeater's Possum
Sites 3, 4, 5	25	4	10	0

LBP had been seen over the road from ANU monitoring site 107 during a spotlight walk in early 2018, and so another site was established there (site 6: see Figures 22 and 23). Sites 3 and 5 were pulled up and the traps moved to Site 6. Sites 4 and 6 were then trapped for another 3 weeks, with no LBP captured (Table 11).

Table 11: Trapping results for sites 4 and 6: Weeks 12, 13 and 14

425 trap nights from 2 April to 6 April 2018
425 trap nights from 9 April to 13 April 2018
425 trap nights from 16 April to 20 April 2018
85 traps
Total trap nights = 1275

	Antechinus agilis	Rattus fuscipes	Possums / gliders	Leadbeater's Possum
Sites 4 & 6	31	4	10	0

Figure 22: Site 6, marked with a red circle, is where an LBP was sighted during a spotlight walk in 2018, following a stagwatch across the road at ANU monitoring Site 107 (purple polygon above red circle). The complexity of disturbances and forest ages can be seen in the various textures of green in this photo.

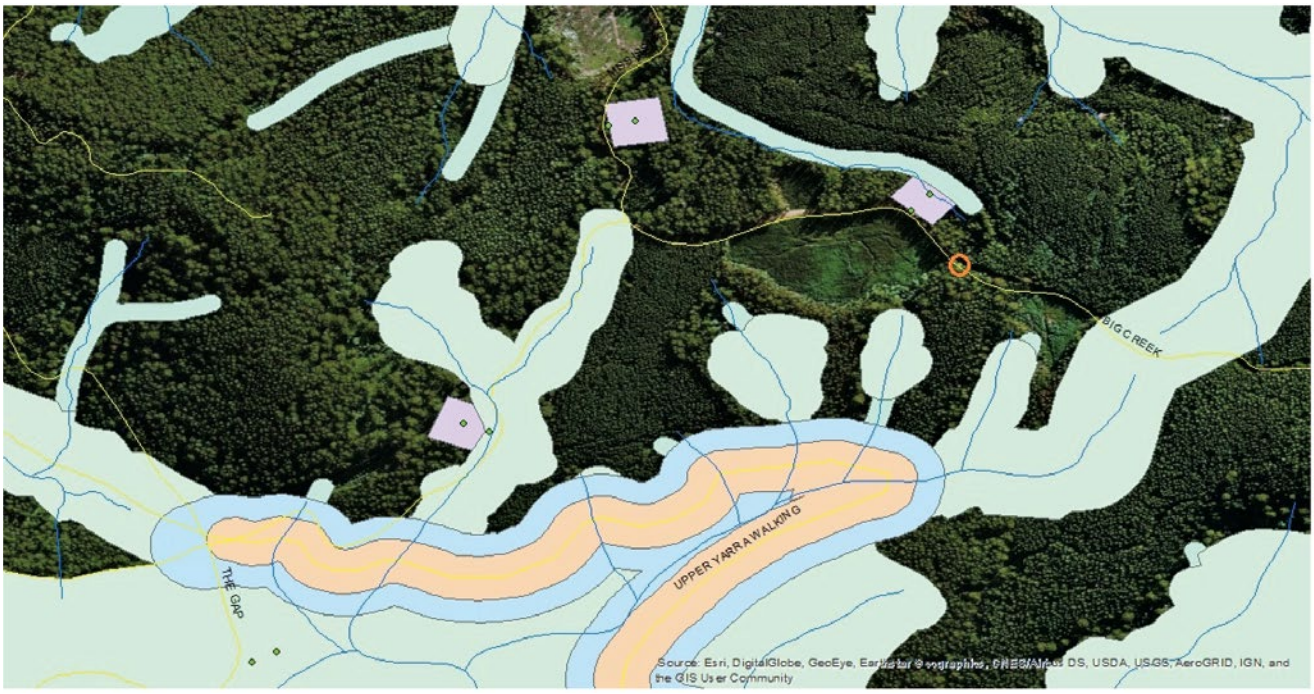

Figure 23: This shows the same area as Figure 22, with Site 6 indicated by the red circle. Coloured polygons show large areas of Special Protection Zones in shades of blue, and National Park in peach. The regrowth within site 6 regenerated after 1981/82 logging, and regrowth adjacent to the site followed clearfell logging in 2014/15. ANU monitoring sites are shown as purple squares.

4.5. Overview of the trapping program

LBP was not common at any of the six sites that were trapped. All trapping sites were of low habitat suitability. Available imagery, historical maps, and ground-truthing revealed that suitable habitat was at least 400 m away from areas that were trapped.

Recent records of LBP in regrowth forests from motion detection cameras, opportunistic surveys, pre-harvest surveys and thermal cameras are presence/absence data only, and LBP presence is unlikely to be a good indicator of high levels of habitat suitability. For example, the area at Dowey Spur used to be a hotspot for LBP but there has been a significant erosion in habitat suitability over the past five years (based on ANU stagwatching data and tree collapse data). There has been substantial loss of hollow-bearing trees at ANU monitoring Site 107 (1939 regrowth) since 2015. Numbers of LBP have likewise declined (from 12 to nil by 2018). Similarly, this site was formerly a reliable location for sightings of LBP over the last 2-3 years (Tim Bawden, personal communication). However, intensive trapping produced no captures of LBP and only one individual was detected in repeated spotlighting surveys. Sites 1 and 2 were marginal habitat at best, with never more than one LBP seen during any previous survey, none caught while trapping for this current study, and the Sugar Glider (which may be competing with LBP) trapped at two sites.

Recent records of LBP in the Victorian Biodiversity Atlas have come from camera trapping, nest box monitoring or incidental sightings. None of these location records have associated demographic data, site-level vegetation surveys, or long-term monitoring information.

Given that our intensive trapping efforts resulted in no captures of LBP, it was decided to explore opportunities to source animals from nest boxes for use in subsequent tracking studies. The work associated with nest boxes is summarized in the following section.

5. Using nest boxes to source animals

Historically, levels of trapping effort have been high to capture very few LBP, even in relatively high quality habitat. Nest boxes are one field method that can provide access to a small number of colonies of LBP. There are 38 Project Possum nest boxes in active LBP territories along Dowey Spur near Powelltown. These nest boxes were surveyed with a thermal camera to distinguish occupied boxes from unoccupied boxes. A total of 11 colonies was detected. In consultation with Zoos Victoria veterinary staff and Dr Dan Harley from Healesville Sanctuary, a date was chosen to source an adult LBP male from one of the more isolated colonies along Dowey Spur. This work coincided with genetic sampling for a study led by researchers from Monash University.

On 8 May 2018, Healesville Sanctuary staff and Lachlan McBurney surveyed a colony 1 km from trap site 6. Nest boxes were checked with a thermal camera to confirm if they were occupied by LBP. The entrance hole of an occupied nest box was blocked. The nest box was then lowered to the ground and members of the colony were removed and placed into a handling bag. Each animal was weighed, sexed and a genetic sample taken. A single individual (the largest adult male in the target colony) was kept in the handling bag and placed in nesting material in a lockable wooden transport crate and driven to Healesville Sanctuary. The remaining animals were returned to the nesting material inside the nest box, and the box was returned to the tree. The nest box door was blocked for 10 minutes to give the colony time to resettle.

5.1. First harness attachment

When it arrived at Healesville Sanctuary, the selected adult male was sedated, parasites were removed, and a blood sample taken. Senior veterinary staff and Dr Dan Harley from the Healesville Sanctuary then oversaw the attachment of the first design of the GPS harness. The flexible neoprene harness fitted well but was a little bulky on a small animal (see Figure 5). Fitting a flexible harness to a sedated possum is a difficult task as the possum's muscles soften under sedation, then tense up again as the sedative wears off. Once the fitting was complete and the team was happy with the attachment, the animal was taken off the sedative and placed in a small nest box in an upright cage, with fresh branches inside, in a dark room adjacent to the Healesville Sanctuary Veterinary Hospital. Observation of the animal as it woke from sedation showed positive results. The animal was observed for a further 25 minutes moving around its cage and climbing the branches provided.

The animal was left alone for five minutes and when the next period of observation began, the animal was found sitting next to the removed harness. The animal was then returned to its nest box in the wild before dusk. Observations of the nest box on dusk showed the animals in the colony emerged within five minutes of each other, including the trial animal.

5.2. Second harness attachment

A second animal was sourced on 30 May 2018. A field trip was co-ordinated with Zoos staff and the selected boxes were checked with a thermal camera, confirming the presence of colonies. The nest box was lifted from its tree and carried to the ground. Four LBPs were removed from the nest material and placed in individual cotton handling bags. Animals were weighed, sexed, and genetic samples were taken. Once all the animals were processed, the largest adult male (135g) was selected, placed in a wooden transport crate with nesting material inside (but left in its handling bag), and transported to Healesville Sanctuary.

The animal was sedated at the Sanctuary by veterinary staff and subjected to a health check, including collection of various parasites from the fur. The second harness design was then fitted. This design had a leather strap instead of the neoprene of the first design. The leather strap attachment is Dr Dan Harley's conventional method for attaching VHF transmitters to LBP. Dr Harley has many years of experience using this method in the field at Yellingbo Conservation Reserve. By anchoring the new experimental GPS harness to the animal using a conventional leather attachment, the ability of animals to squeeze out of the harness was removed.

Once the fitting was deemed to be satisfactory by the veterinary staff, the animal was taken off the sedation and allowed to wake. As the animal woke, it became very active in the handling bag. As it did so, it was seen to have its rear foot stuck through the neoprene chest band of the harness. The harness was promptly cut off and the animal returned to its handling bag and transport box. Once it had recovered from the sedative, it was returned to the nest box capture site before dusk and the handling bag placed on top of the nest inside the box. The box was watched and the colony emerged and moved off into the forest.

LBP colonies will sometimes flush from a nest box that has been disturbed by handling/checking the animals inside (Dr Dan Harley, personal communication). This meant that two of the 11 occupied nest boxes along our target area of Dowey Spur had been 'used up' for these two trials, and it was unknown when an LBP colony might re-occupy them. This reduced the pool of nest boxes available for the trial of the finalised harness design.

The installation of nest boxes across the broader Central Highlands region has been focussed on sub- alpine and higher elevation montane forest. The only nest boxes available in a regrowth-dominated landscape are those on Dowey Spur and along Snobs Creek Road in the Rubicon Valley.

Reducing the availability of an already small number of nest boxes in regrowth through these trials was becoming a problem. To address this, Healesville Sanctuary veterinarians and Dr Dan Harley proposed the use of the two captive LBP in the Nocturnal House at the Sanctuary to finalise and fine tune the GPS harness design.

The Sanctuary has two captive LBP sourced from Lake Mountain following the Black Saturday bushfires in 2009. There is an extensive network of nest boxes across the sub-alpine plateau at Lake Mountain established in the early 2000s. The plateau was burnt at high severity in the 2009 fire and the nest boxes were closely monitored in the months following the fire. A pair of LBPs was found in marginal habitat in an area where the Feral Cat (Felis catus) had been detected by remote cameras. The decision was made to bring the animals to Healesville Sanctuary. They are the only Central Highlands LBPs in captivity, and are not a part of the breeding program at Healesville Sanctuary (which is focussed on lowland animals from Yellingbo Conservation Reserve). This made the Lake Mountain animals good candidates for the fine tuning of the harness design. They are easy to capture from their nesting areas, the veterinary staff are on-site, and the Nocturnal House pens provide an excellent viewing area to watch animal's behaviour whilst wearing the GPS harness.

The decision to use captive animals required additional approvals from Zoos Victoria and the Victorian Animal Ethics Committee for the use of the captive animals in a GPS harness trial. This was a complex application involving animals on display at Healesville Sanctuary, public visibility of a trial harness design, captive animals in which the Healesville Sanctuary had invested a lot of resources, multiple teams within the Zoos Victoria staff working at the Sanctuary, and health concerns for the older captive LBP.

One of the captive animals from the Nocturnal House died in the 6-month period during which the ethics application progressed. The remaining possum was brought in for assessment and it was found to be in poor health. This changed the application process for the harness attachment trial to the use of the unpaired animals from the breeding program. This new arrangement meant that the harnessed animal would not be on public display in the Nocturnal House. This would enable a more realistic assessment of behaviour, as the nest boxes used for these animals are the same design as those in the wild, and the breeding pens are quite large and well vegetated, with structures to facilitate animal movement. Cameras record the animal activity in the pens, so staff can live view the harnessed animals before, during and after the trial and assess any behavioural changes.

6. VHF radio-tracking of Leadbeater's Possum and nest box use

Although the use of nest boxes is well studied at Yellingbo Conservation Reserve, and many nest boxes have been installed throughout the Central Highlands of Victoria, limited research on their use has been undertaken (except for the presence/absence of colonies). Nest boxes in the Project Possum are part of a program run by Parks Victoria. Over 500 nest boxes have been installed in pairs at sites selected by Dr Dan Harley and based on known records of LBP and suitable habitat. Careful box placement around movement pathways and dense midstorey vegetation, plus targeting high quality habitat, has meant that 30% of nest boxes in Ash forests boxes have had signs of occupation by LBP (Harley, 2015). When a colony has started using one of the two nest boxes, two more nest boxes are installed nearby to the occupied sites (giving four nest boxes in total). The use of these nest boxes in the Central Highlands has not been well understood, other than rates of nest box occupancy.

To ascertain how animals were moving between nest boxes, including colonies shifting after a nest box has been disturbed for sampling and measurements, we attached small VHF trackers to large male LBPs from colonies in the Upper Yarra region. The Dowey Spur nest boxes were left undisturbed for use in the GPS study, as well as maintaining the integrity of other research programs operating at that time (including studies of feral cat trapping and remote cameras, thermal properties of nest boxes using temperature buttons, and genetic sampling).

Over several weeks, a thermal camera was used to survey 30 nest boxes in the Upper Yarra/Toorongo region (see Figure 24). This is an excellent survey tool for nest boxes, but has limited use for detecting animals occupying natural hollows in large old hollow-bearing trees. This is due to the natural thermal properties of the large old trees limiting the capabilities of the thermal camera.

Four nest box sites were selected for detailed study in the Upper Yarra/Toorongo region and a field day was co-ordinated with Healesville Sanctuary staff to coincide with a genetic sampling field trip. During the three field days, six colonies in nest boxes were processed and three suitable candidates for radio-tracking were chosen. Members of each colony were weighed and measured and genetic samples taken. The larger males (>125g) were selected for fitting of a conventional VHF radio transmitter on a leather collar. Once an animal was fitted with a VHF collar, all members of each colony were returned to their nest box and the entrance door was blocked for 5-10 minutes while the colony settled back in to the nest. The three collared animals were radio-tracked every 2-3 days for three months.

Figure 24: Thermal camera images of nest boxes. The recycled plastic nest box materials transmit the heat of the possum colony inside. The position and size of the heat signal can be used to determine species inhabiting a nest box. Heat signals of a LBP colony show as pink in the nest boxes at left and centre. The right hand image shows an unoccupied nest box with no heat signal.

6.1. Results of VHF radio-tracking

Each nest box site had at least two boxes within 100 m of each other. The first day of radio-tracking resulted in two of the three colonies shifting dens from the original source nest box to the second nest box in the area.

One of the collared animals moved 600m to a marginal natural hollow in a highly decayed Alpine Ash (*Eucalyptus delegatensis*) tree. This animal occupied the same natural hollow for two months. The collared animal was stagwatched emerging from the tree on three occasions. In the last two weeks of the tracking period, this collared animal moved 700m to another dead hollow-bearing tree (Figure 25). The other two collared animals spent the whole tracking period using nest boxes, but they used them very differently. The first stayed in a second nest box for the entire tracking period. The second animal used the second and source nest boxes equally, swapping between boxes approximately every two weeks.

Each collared animal remained part of a larger colony. Collared individuals were seen with more than one other animal each time they were stagwatched. Each colony returned to its source nest box. This is critical information, as the broader GPS tracking project is looking to access animals from nest boxes, so limiting the impact on nest box colonies and nest box occupancy is an important factor to consider in terms of limiting the effects of the radio-tracking work on LBP.

Figure 25: A degraded Alpine Ash den tree (classified as Form 8; see Figure 2) and used by a collared LBP. The red arrow points to nesting material, which is one third of the way up the tree in an open crack.

7. General discussion

Despite 5775 nights trapping in regrowth forests over 2017 and 2018, not a single LBP was caught. Six sites, all with recent records of LBP, were trapped without success. Multiple trap types, trap heights, bait mixes and trap placement were unsuccessful in capturing LBP. Parts of each site's unique features were targeted with no success (i.e. slopes, gullies, Acacia thickets, old trees). Techniques that have been used successfully elsewhere did not produce results for this project. Each of the six sites was subject to approximately two weeks assessment prior to traps being set, with best locations within each site targeted for trapping. The only site that was not investigated as thoroughly as the others was Dowey Spur, due to the assumption that it was a known hotspot for LBP. Further investigation of each of the six sites (after trapping finished in 2018), to try to understand the lack of captures, showed potential habitat > 400m away from the trapping locations. If the specific areas trapped did not support many LBP, this could be where a larger colony may occur in the surrounding landscape.

If new sites are to be trapped for LBP, this study provides two key lessons. First, a prolonged period should be dedicated to ground-truthing for signs of larger colonies. If an LBP detection record is the sole basis for site selection, the chances of capture success are likely to be small. Second, it is valuable to connect a location record of LBP with knowledge of the den trees that are occupied. At Cambarville, past trapping success was generally higher closer to known den trees (D. Lindenmayer, personal communication). Trapping success may be boosted by spending time surveying habitat surrounding a location record.

The opportunity to use nest boxes occupied by known colonies of LBP offered a method of quickly and repeatedly accessing animals. LBP from nest boxes will enable us to gather information on their use of regrowth habitat, which is the central theme of this study. However, it is not known whether animals using only tree hollows (in the absence of nest boxes) behave in the same way as those occupying nest boxes.

A trapping trial near known occupied nest boxes has been proposed to eliminate the need to disturb a whole colony when sampling animals from a nest box. This has been successful at Yellingbo Nature Reserve in the past (Dr Dan Harley, personal communication). Further work on trapping LBP near known den trees would provide another possible way to access animals, although this could be very time consuming.

The decision to use nest boxes to source animals for the study has allowed us to have access to known colonies of LBP based on annual checks of nest boxes. It has provided access to approximately 20 colonies in two regrowth landscapes, with potential future colonies in montane forest and sub-alpine forests.

Cooperation between multiple stakeholders has been beneficial to the project. Healesville Sanctuary staff have been generous with their time and expertise. The partnership has meant a significant amount of time has been required to coordinate the logistics, but it assured the welfare of the animals in the wild. The partnership and the decision to use captive animals to finalise the harness design with a captive animal trial has been the right decision for the welfare of LBP, but it necessitated a delay of the first trial to ensure that all approvals were in place. Coming after a year of unsuccessful trapping, this added to the timeline of the project.

Up to 20 staff from Zoos Victoria have been involved in the GPS harness project, with significant time and resources committed to the work. This includes the invaluable experience of Dr Dan Harley, whose field experience with LBP is second to none. Handling LBP is a difficult task and Dr Harley's methods have been refined and practised over several decades.

8. Latest work

The next stage of this project (which commenced in April 2019), is to complete the harness trials at Healesville Sanctuary. The trials are in two stages. The first trial involves attaching a harness to a sedated LBP; the second stage involves attaching a harness to an unsedated animal. In both stages, the animal will be observed and monitored for 72 hours to assess the harness fitting procedure and the harness design and whether it affects the animal's behaviour.

The first harness trial was conducted on 30 April 2019 and was successful. Six LBP were brought in from the Sanctuary's breeding facility to the wildlife hospital at the Healesville Sanctuary and one animal was deemed suitable for harness attachment. The sedated animal had the harness carefully fitted (see Figure 26). An observation team viewing the nest box via a remote camera in the laboratory observed the animal emerge and undertake normal nocturnal behaviours.

The harnessed animal was viewed for 24 hours a day for 3 days. Behaviours and activity were recorded by two staff who stayed at the Healesville Sanctuary overnight and one staff member during the day to ensure the animal was still behaving normally.

After the third night, the animal was caught from the nest box and the harness removed. The senior veterinarian at the Healesville Sanctuary assessed the health of the animal and checked for any rubbing or wear. The animal was in good health with no signs of wear from the harness. A report is being currently being prepared on the results of the first trial.

Figure 26: Harness fitted to a Leadbeater's Possum during the first stage of the harness trial at Healesville Sanctuary on 30 April 2019.

The second phase of the work will be to attach a harness to an unsedated animal to assess whether this procedure can be done in the field without the need for transportation and sedation (transportation can be up to two hours drive from the field site to the veterinary clinic at Healesville Sanctuary). This trial will commence in early June 2019.

If both trials are successful, subsequent work will be to attach GPS harnesses to wild animals. This will begin with surveying nest boxes along Dowey Spur for currently occupied boxes and identifying suitable candidates for the GPS harness attachment. Initially, harnesses will be attached to two individuals from two colonies along Dowey Spur. Discussion with statisticians about the broader implementation of the GPS-tracking program across other nest box sites (to determine the number of harnessed animals, seasonal change assessments, and number of locations) will guide this next stage of harness attachment.

While the two trials are underway at the Healesville Sanctuary, there will be ongoing searches for suitable colonies in regrowth forests to find den trees close to where animals have been sighted. Trapping around known natural den trees and extensive camera trapping will be used identify common movement pathways to target for trapping to further boost access to wild animals.

Continued nest box installation in regrowth forest areas around Toolangi and in bushfire regrowth is underway, accompanied by extensive camera trapping by Zoos Victoria to confirm presence/absence of LBP.

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Further information:

http://www.nespthreatenedspecies.edu.au/

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