

# Targeted surveys for Leadbeater's Possum in 2014-2015

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Arthur Rylah Institute for Environmental Research

Report for the Leadbeater's Possum Implementation Committee





# **Targeted surveys for Leadbeater's Possum in 2014-2015**

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**Front cover photo:** Leadbeater's Possum photographed during targeted surveys (DELWP, ARI)

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## Summary

In 2014 the Leadbeater's Possum Advisory Group made several recommendations to support the recovery of Leadbeater's Possum in the Central Highlands. One of these was to establish timber harvest exclusion zones, or buffers, around all verified records of the species from the last 15 years and all new verified records of the species. To support implementation of this recommendation, camera trap surveys were used to locate new colonies of Leadbeater's Possum across the species' Central Highlands range and build new validated records. Surveys were done between November 2014 and May 2015. Survey sites targeted areas predicted by modelling as having a high probability of occupancy by Leadbeater's Possum (i.e. >65%) within State forest, including areas on VicForests' current Timber Release Plan (TRP). These areas are currently under a timber harvesting moratorium while surveys are being conducted. Surveys also targeted areas close to existing records and to new records obtained during the surveys, to potentially form clusters of records and increase protection for adjacent colonies and hence enhance the longer term viability of these colonies.

A total of 113 sites were surveyed for the presence of Leadbeater's Possum, using two camera traps per site. Cameras were set by tree canopy specialists at heights ranging from 3 – 36 m to target the vegetation layer most likely to be used by the possums at each site for moving through the forest and/or foraging. The surveys resulted in 5386 camera nights and over 180,000 photographs to examine for the species. Leadbeater's Possum was detected at 50 sites (44% of surveyed sites). The highest success rate was from the Toorongo Plateau/Noojee area where the species was detected at 72% of surveyed sites. Leadbeater's Possums were detected at 49% of the sites sampled in areas predicted by modelling as having a greater than 65% likelihood of being occupied by the species, compared to only 13% in the 0 - 30% category. Another factor that influenced detection success was proximity to existing records, with half of the detections being from sites adjacent to existing buffered records or new records. Several clusters of records were developed, particularly in the Toorongo Plateau/Noojee area where surveys detected two clusters of five and one cluster of eight sites with possum detections.

As all sites surveyed were in State forest, and have undergone either fire or timber harvesting, all sites can be broadly considered 'regrowth'. Leadbeater's Possum was detected across all age-classes of forest surveyed, with a similar proportion of records from 1939 and 1983 fire regrowth (25% and 27% of cameras, respectively) and a higher proportion of detections in regrowth forest from timber harvesting between 1978-2000 (38% of cameras). As the camera-trapping survey technique records individuals where they are foraging rather than where they nest, colonies recorded in younger regrowth forest are most likely nesting in nearby older forest or in older trees, if present, within the younger regeneration. Leadbeater's Possum was detected in areas that were scheduled for timber harvesting, with the species recorded at 15 of the 42 sites sampled (36%) on the current Timber Release Plan. This result highlights the value of undertaking surveys prior to harvesting to better protect resident colonies located in areas scheduled for timber harvesting.

Although Leadbeater's Possum was recorded at 44% of the sites surveyed, sites actively targeted high quality habitat and areas close to where the possum is known to occur, so these results cannot be extrapolated to the likely proportion of occupied sites throughout the species' range. As the current approach of targeting camera placement and site selection to areas considered more likely to contain Leadbeater's Possums resulted in a relatively high rate of possum detections on surveyed sites, and was therefore a successful technique, it will be continued for the surveys planned for 2015-16. Although preliminary analysis indicates a moderately high probability of detecting the species where it occurs, to increase this detection rate further, three (instead of two) camera traps will be set at each site during the 2015-16 surveys. The combined survey results from both years and detailed habitat measurements being collected at each site will then be analysed to refine predictions of the distribution and habitat requirements of Leadbeater's Possum throughout its range.

Timber harvesting exclusion zones have now been established around all sites where Leadbeater's Possum was recorded during these surveys, thus providing increased protection of existing colonies to support the



species' recovery. In addition, the targeted survey program for 2015-16 has been fast-tracked to accelerate the identification of new colonies for protection and it is anticipated that approximately 180 new sites will be surveyed. These new sites will be spread throughout the species' range to increase the likelihood of a new protection zones in a number of different areas to spread the risk to the species' from future large bushfires. Where possible, clusters of exclusion zones will continue to be developed to provide protection for larger numbers of colonies, thereby increasing the prospect for long-term persistence of the species in these areas.

# 1 Introduction

Victoria's state faunal emblem, Leadbeater's Possum *Gymnobelideus leadbeateri*, is listed as Critically Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act*. In 2013, the Leadbeater's Possum Advisory Group (LPAG) was established to provide recommendations that support the recovery of Leadbeater's Possum while maintaining a sustainable timber industry. A key recommendation from LPAG was to protect known Leadbeater's Possum colonies by establishing a 200 m radius timber harvesting exclusion zone around records from the last 15 years and around all new verified records (Leadbeater's Possum Advisory Group 2014a). As the locations of only a proportion of colonies are currently known, a key LPAG action was to undertake targeted surveys to locate additional colonies for protection.

Leadbeater's Possum is restricted to an area of approximately 70 x 80 km in the Central Highlands of Victoria, northeast of Melbourne, and a small, lowland area east of Melbourne in the Yellingbo Nature Conservation Reserve. Within the Central Highlands it occurs in two distinct broad vegetation types: montane ash forests (dominated by Mountain Ash *Eucalyptus regnans*, Alpine Ash *E. delegatensis* or Shining Gum *E. nitens*), and sub-alpine woodland (dominated by Snow Gum *E. pauciflora*). There are approximately 204,400 ha of potential ash forest or Snow Gum woodland habitat within the range of Leadbeater's Possum, the majority of which is ash forest (96%), with 4% Snow Gum woodland (Leadbeater's Possum Advisory Group 2014b).

To improve understanding of the distribution of Leadbeater's Possum, the Arthur Rylah Institute (ARI), in the Department of Environment, Land, Water and Planning (DELWP), conducted surveys for Leadbeater's Possum in 2012 at 180 sites throughout the Central Highlands (Lumsden *et al.* 2013). Based on these survey results, an occupancy model was developed that assessed the relative value of habitats for the species and predicted areas throughout the range where Leadbeater's Possums are most likely to occur. To minimise the risk of harvesting in areas where the species is likely to occur, LPAG recommended a two year timber harvesting moratorium to enable further surveys to be undertaken, to determine which of these areas are actually occupied. The moratorium was applied to areas within State forest where the model predicted Leadbeater's Possum has a greater than 65% probability of occurring (Leadbeater's Possum Advisory Group 2014a). These areas of predicted high probability, particularly where they overlap with the current Timber Release Plan, are a key focus for surveys to locate new colonies for protection.

The surveys were recommended to be spread over several years. This progress report summarises the results of the first year of the targeted surveys, which were undertaken in 2014/15.

## 2 Methods

### 2.1 Site selection

To maximise the number of new Leadbeater's Possum colonies located for protection, a targeted sampling approach was adopted, with a focus on areas considered most likely to be occupied by the species. This included targeting:

- modelled 'high probability of occupancy' areas from ARI's existing occupancy models (Lumsden *et al.* 2013) focusing on the greater than 65% probability areas, where there is currently a timber harvesting moratorium, plus adjacent areas with lower probability of occupancy;
- locations near Leadbeater's Possum records from within the past 15 years and close to newly located colonies to develop clusters of colonies for protection; and
- known hotspot areas with a high density of records (e.g. 1983 fire regrowth in the Yarra State Forest between Warburton and Powelltown).

As the key purpose of the surveys was to identify and map Leadbeater's Possum colonies and clusters of colonies for protection from timber harvesting, all sites were located in State forest in areas available for harvesting i.e. General Management Zones (GMZ) or Special Management Zones (SMZ). Only vegetation types that Leadbeater's Possum is known to use were surveyed, which included ash forest (stands dominated by either Mountain Ash, Alpine Ash or Shining Gum), Cool Temperate Rainforest (dominated by Myrtle Beech *Nothofagus cunninghamii*), and Montane Riparian Thicket (dominated by Mountain Tea-tree *Leptospermum grandifolium*). Sampling was not undertaken in Snow Gum woodlands as these habitats are all within parks and reserves not available for harvesting. Sites were spread mostly across the southern part of the species' range (see Figure 4 in the Results section for survey site locations).

Sites included a wide range of forest age classes and disturbance histories, with forest stands ranging in age from 15 – 76 years, and included timber harvesting regrowth, 1983 bushfire regrowth and 1939 bushfire regrowth. The only common age classes that were excluded from sampling were regrowth from timber harvesting within the last 10 years, and areas that were burnt during the 2009 bushfires as these have a low probability of colonies being present (Lindenmayer *et al.* 2013, Lumsden *et al.* 2013). No sites were surveyed in age classes older than 1939 regrowth as few stands of older forest remain in State forest within GMZ or SMZ. Some sites, however, had individual older trees within the area sampled and these will be documented as part of habitat assessments being undertaken at each site.

Sites were selected based on the occupancy model and their proximity to other records (i.e. within 500 m), rather than the age of the forest or the abundance of obvious habitat features (e.g. hollow-bearing trees). By using this approach it will be possible to investigate the influence of the availability of these features for defining suitable foraging habitat. As the survey method we used (described in the Survey method section) records the species where it is foraging rather than nesting, further studies will be required to document where nesting habitat is located.

Areas identified by modelling as having a greater than 65% probability of occupancy by Leadbeater's Possum that overlapped with the current (2013-2016) Timber Release Plan (TRP) were a key focus for the surveys. Sampling was also undertaken in coupes designated for harvesting under the TRP where the probability of occupancy was less than 65%. Such areas typically had existing Leadbeater's Possum records within or close to the proposed coupe (i.e. within 500 m) so were also considered a high priority for survey.

Sites were also selected for survey in State forest outside areas that overlapped with the current TRP. Although not currently scheduled for timber harvesting, being in GMZ or SMZ, these areas are available for harvesting in the future. This enabled a more strategic approach to protect the highest priority areas, including some areas on the current TRP and other key areas that would be scheduled for harvesting

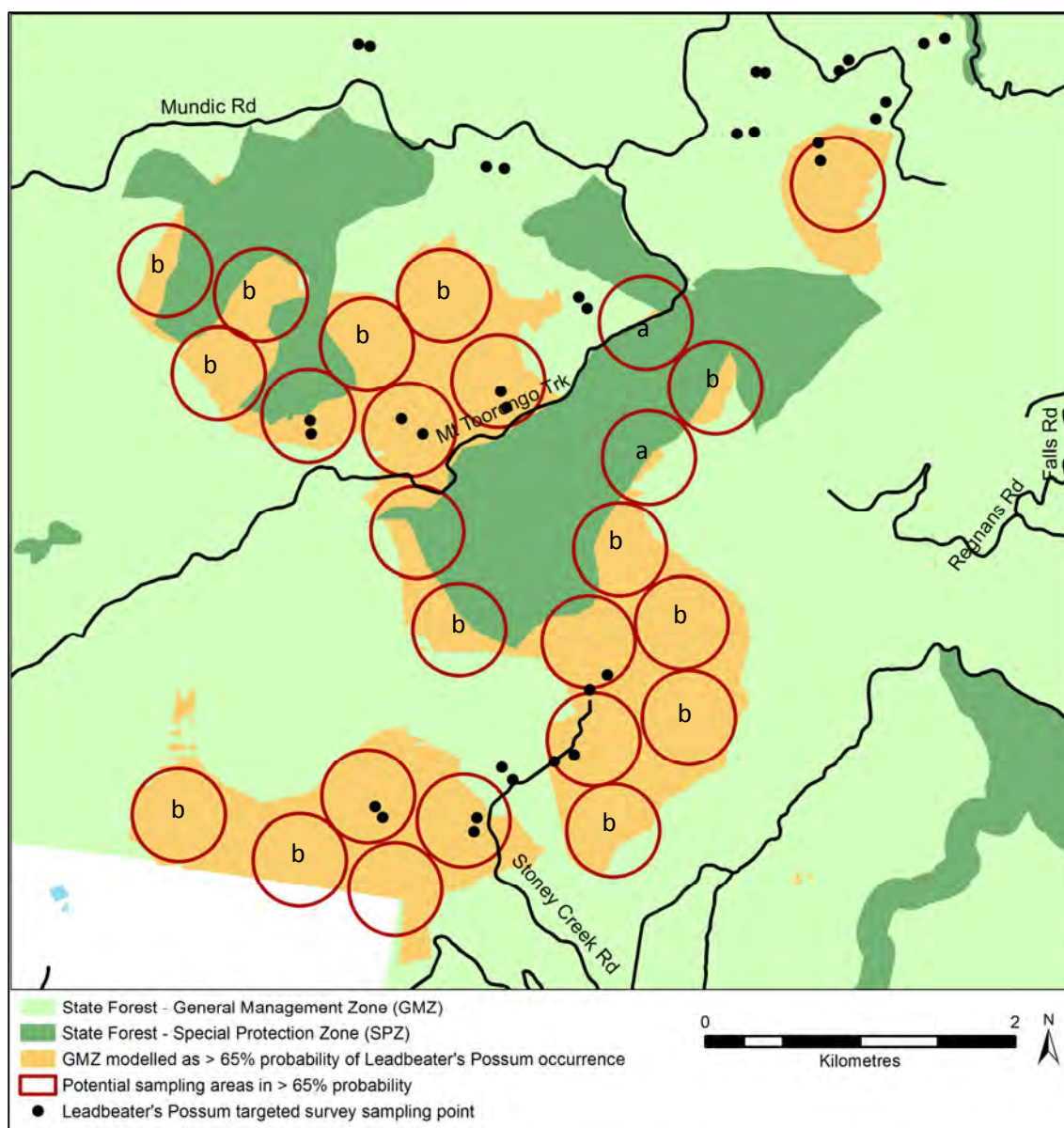
subsequent to 2016. As with areas on the TRP, site selection focussed on forest within 500 m of existing records and included areas with a lower than 65% probability of occupancy.

### **2.1.1 Survey site delineation**

To assist with site selection, ArcGIS software was used to divide areas of State forest with greater than 65% probability of occupancy by Leadbeater's Possum into potential survey sites using 300 m radius circles covering a forest patch (Figure 1). Although any resulting exclusion zone would be 200 m in radius, a 300 m radius circle was used for site selection as the survey equipment was generally installed within 100 m of the centre of each site. This ensured that new and adjacent records of Leadbeater's Possums would be separated by at least 400 m, with no overlap with areas already protected for nearby colonies, thereby maximising the area of habitat protected by the subsequent 200 m radius timber harvest exclusion zone. After excluding potential sampling areas that had been harvested in the last 10 years, 131 potential survey sites remained within the areas having greater than 65% probability of occupancy. Some areas were then excluded because the area containing the greater than 65% probability area was small, and largely surrounded by either Special Protection Zones or parks, or overlapped considerably with existing buffered records. A large number of potential sites (52 sites) were unable to be sampled because they were prohibitively difficult to access. The dense understorey in ash forests can often mean that even 200 m can take over an hour to traverse. Therefore, sites greater than 400 m from a track were excluded, from both a safety perspective when trying to move through dense, tangled vegetation carrying heavy packs (up to 25 kg); and from an efficiency perspective, because a team of two may only be able to install survey equipment at one site a day if sites were far from tracks. Overall, 65 sites delineated in the greater than 65% probability category were considered available for survey.

### **2.1.2 Colony clusters**

To determine whether there are colonies adjoining known colonies, and to develop clusters of colonies for enhanced protection, sites were surveyed adjacent to either Leadbeater's Possum records with existing 200 m buffers, or to new records obtained during the surveys such that any new record obtained was 400 m from the existing records. If Leadbeater's Possums were detected in the adjacent site, then additional sites were surveyed in the surrounding area on subsequent field trips to further build up the cluster (see Figure 6 in Results).



**Figure 1. Example of the site selection approach in the Toorongo Plateau/Noojee area, using 300 m radius circles to delineate potential sampling sites.** Areas that were sampled are shown by the black sampling points, with two cameras per site. Areas that were not sampled are indicated using the following letters: a – due to the small size of the greater than 65% probability area; b – due to being prohibitively difficult to access (i.e. more than 400 m from tracks). Some sites in this area are still available for sampling.

## 2.2 Survey method

Sampling was undertaken using remote cameras (referred to as 'camera traps') set high above the ground in the canopy or understorey. Two camera traps were installed at each site, set approximately 100 m apart. Both camera traps were generally located at least 200 m from the edge of roads or tracks, particularly where the width of the road or track resulted in no connecting vegetation over the road to facilitate animal crossings. This approach was taken to reduce fragmentation within resulting timber harvesting exclusion zones and to maximise the area protected. Each camera trap consisted of a Reconyx survey camera (Reconyx, Inc., supplied by Faunatech/Austbat, Bairnsdale; either Professional Series PC900 Professional Covert IR, or HyperFire Series HC600 Covert IR or HC500 Semi-covert IR) mounted on a tree trunk and set opposite a bait station containing creamed honey (Figure 2). These cameras are triggered by heat in motion, typically when an animal that is warmer than the surroundings moves in front of the camera. Advanced camera settings were used including with a high sensitivity level for the motion detector, five



pictures per trigger, a RapidFire picture interval and no delay between successive triggers. Professional series cameras were programmed to turn off during the day. This provided more flexibility in camera placement as cameras could be set faced into direct sunlight without excessive false triggering caused by sun-warmed moving vegetation. Bait stations were mounted either on a branch of the same tree as the camera, or on the trunk or a branch of an adjacent tree, typically 2 - 3 m away. Camera traps were installed by tree canopy specialists (Treetec, Menzies Creek), experienced in setting cameras for Leadbeater's Possum. Each tree canopy specialist worked with an ARI staff member to identify suitable habitat and optimal locations for camera traps on survey sites. Camera traps targeted areas of well-connected vegetation where Leadbeater's Possums were most likely to be moving/foraging at the height of the camera/bait station and could trigger the camera when moving along the lateral branches as well as at the bait.

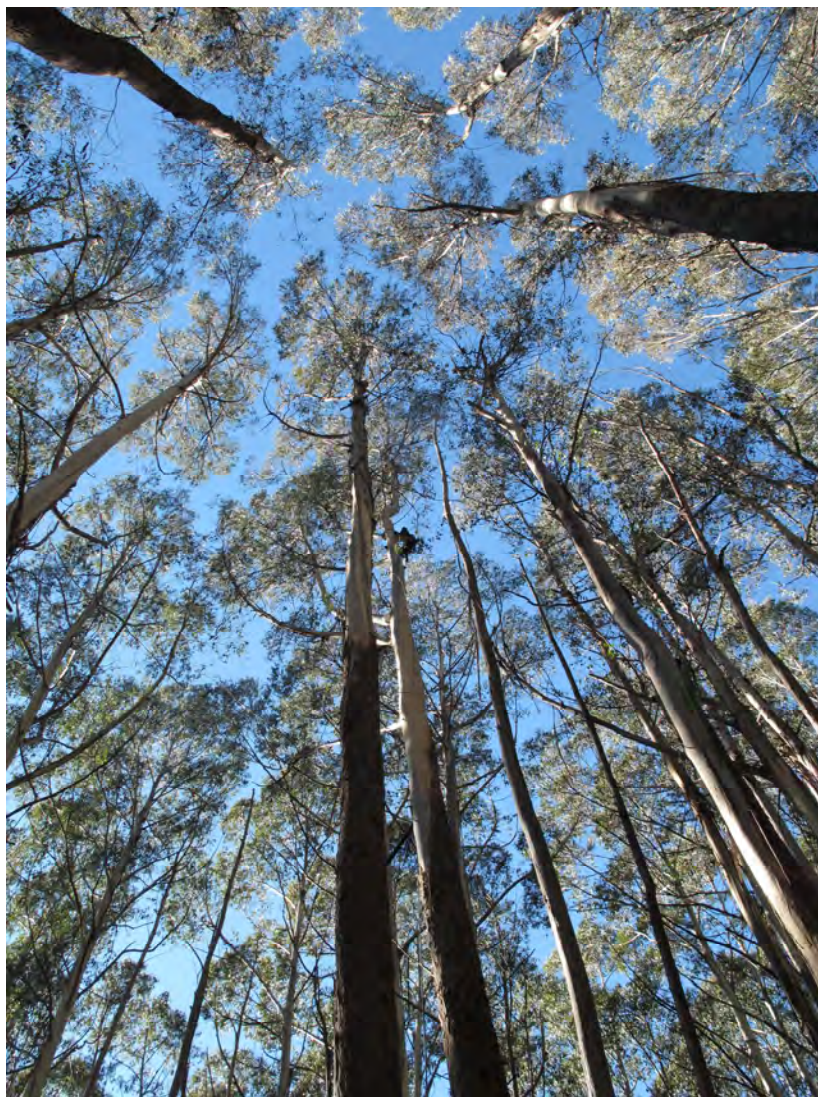
Camera traps were set 3 - 36 m above the ground, with the height varying with the habitat present at each site. For example, cameras were set lower in 1983 regrowth where there is a dense layer of understorey and regenerating eucalypts typically less than 10 m high; while in 1939 regrowth, where the canopy is high and the sparse wattle layer is often taller than 15 m, cameras were set much higher (Figure 3).

Camera traps were left onsite for a minimum of 21 nights. After the cameras were retrieved, images were downloaded and thoroughly scrutinised for the presence of Leadbeater's Possum. Other species detected at each site were also documented. Records of all species detected during the surveys have been entered into the Victorian Biodiversity Atlas. Whether or not Leadbeater's Possums were detected each night of the survey on one or both cameras was documented to enable examination of detection probabilities. This detailed analysis will be undertaken in full at the end of the second year of survey (2015-2016).



**Figure 2. Camera trap consisting of a Reconyx survey camera (circled left) set 2 – 3 m from a bait holder containing creamed honey (circled right).**





**Figure 3. The use of tree canopy specialists to install camera traps enabled access to all levels of the forest.**

## **2.3 Habitat assessments**

Another component of the targeted surveys was to improve existing habitat models and the understanding of Leadbeater's Possums' habitat requirements. To achieve this, measurements of habitat attributes known to be strongly correlated with the presence and abundance of Leadbeater's Possum are being collected at each site. These include age class, dominant eucalypt species, density and form of hollow-bearing trees, basal area of wattle and extent of connectivity (Smith and Lindenmayer 1988, Lindenmayer *et al.* 1991a). Hollow-bearing trees are being assessed based on the definition of mature or senescent hollow-bearing trees used for Zone 1A habitat identification in the Leadbeater's Possum survey standards (DELWP 2015). Trees are also being assessed using ecological criteria that documents any tree that contains hollows and so may provide den sites for Leadbeater's Possum, irrespective of the age or species of the tree. Analysis of the habitat data will be used to refine current distribution and habitat models (Lumsden *et al.* 2013) to improve predictions of areas most likely to contain Leadbeater's Possum colonies. These new data will also allow an evaluation of the current method of assessing potential denning resources for Leadbeater's Possum against ecological criteria.

The collection of habitat data from all sites sampled during 2014-15 is currently being finalised. These data will be combined with habitat data collected at sites sampled in 2015-16, and analysed and reported on at the end of the second year of the surveys.

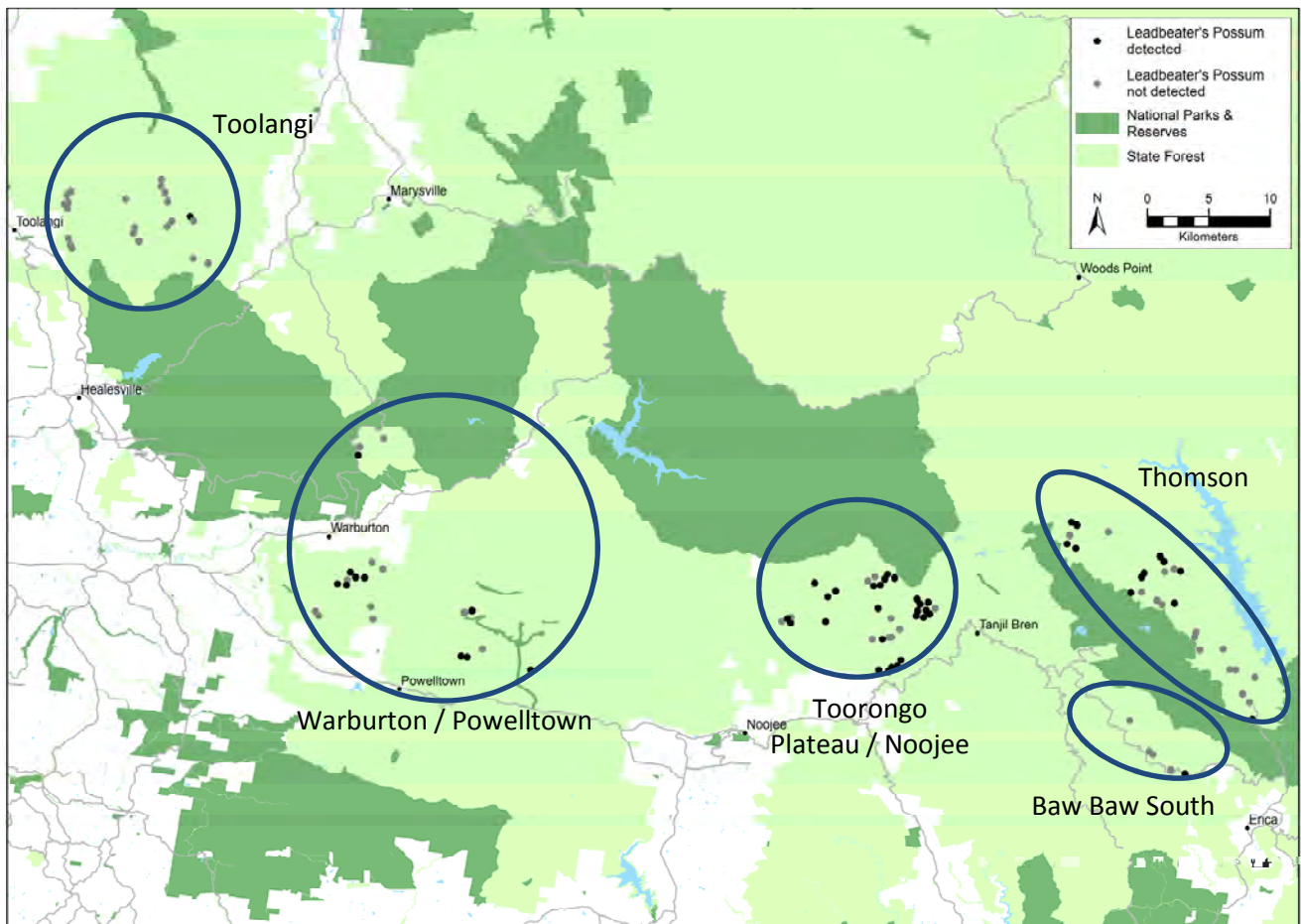
### 3 Results

#### 3.1 Survey results

One hundred and thirteen sites were surveyed for the presence of Leadbeater's Possum between November 2014 and May 2015, resulting in a total of 5386 camera nights. Sites were located in five main parts of the species' range: Toolangi (22 sites), Warburton/Powelltown (22 sites), Toorongo Plateau/Noojee (36 sites), east of Baw Baw National Park (28 sites), and south of Baw Baw National Park (5 sites) (Figure 4: and see Figure 6 and Appendix 1 for finer scale maps of the main survey areas).

Over 180,000 photographs were obtained and scrutinised for images of Leadbeater's Possums and other arboreal mammals (examples in Figure 5). In most instances, one individual Leadbeater's Possum was captured in a photo, while in a small number of cases up to four were photographed at once. There were some rare occasions where Leadbeater's Possums were photographed seemingly interacting with other possum species (Appendix 2).

Leadbeater's Possums were detected at 50 sites (44% of surveyed sites). The highest success rate was from the Toorongo Plateau/Noojee area where the species was detected at 72% of surveyed sites, while only 5% of the surveyed sites in the Toolangi area recorded Leadbeater's Possums (Table 1).



**Figure 4. Leadbeater's Possum survey sites in five areas across the Central Highlands, showing where the species was recorded (black dots) and where they were not recorded (grey dots), November 2014 – May 2015.** The five survey areas are: Toolangi (Toolangi State Forest), Warburton/Powelltown (Yarra State Forest), Toorongo Plateau/Noojee (Noojee State Forest), Thomson (Thomson State Forest), and Baw Baw South (Tanjil State Forest).





**Figure 5. Images of Leadbeater's Possums captured using camera traps during targeted surveys in the Central Highlands, November 2014 – May 2015.**

**Table 1. The number of sites surveyed for Leadbeater's Possum (LBP) using camera traps, and the proportion of Leadbeater's Possum detections across five main areas of the species' Central Highlands range, November 2014 – May 2015.** See Figure 4 for the five survey area locations.

Survey area	No. of sites	No. of sites with LBP detections	% of sites with LBP detections
Toolangi	22	1	5
Warburton/Powelltown	22	10	45
Toorongo Plateau/Noojee	36	26	72
Thomson	28	12	43
Baw Baw South	5	1	20
<b>Total</b>	<b>113</b>	<b>50</b>	<b>44</b>

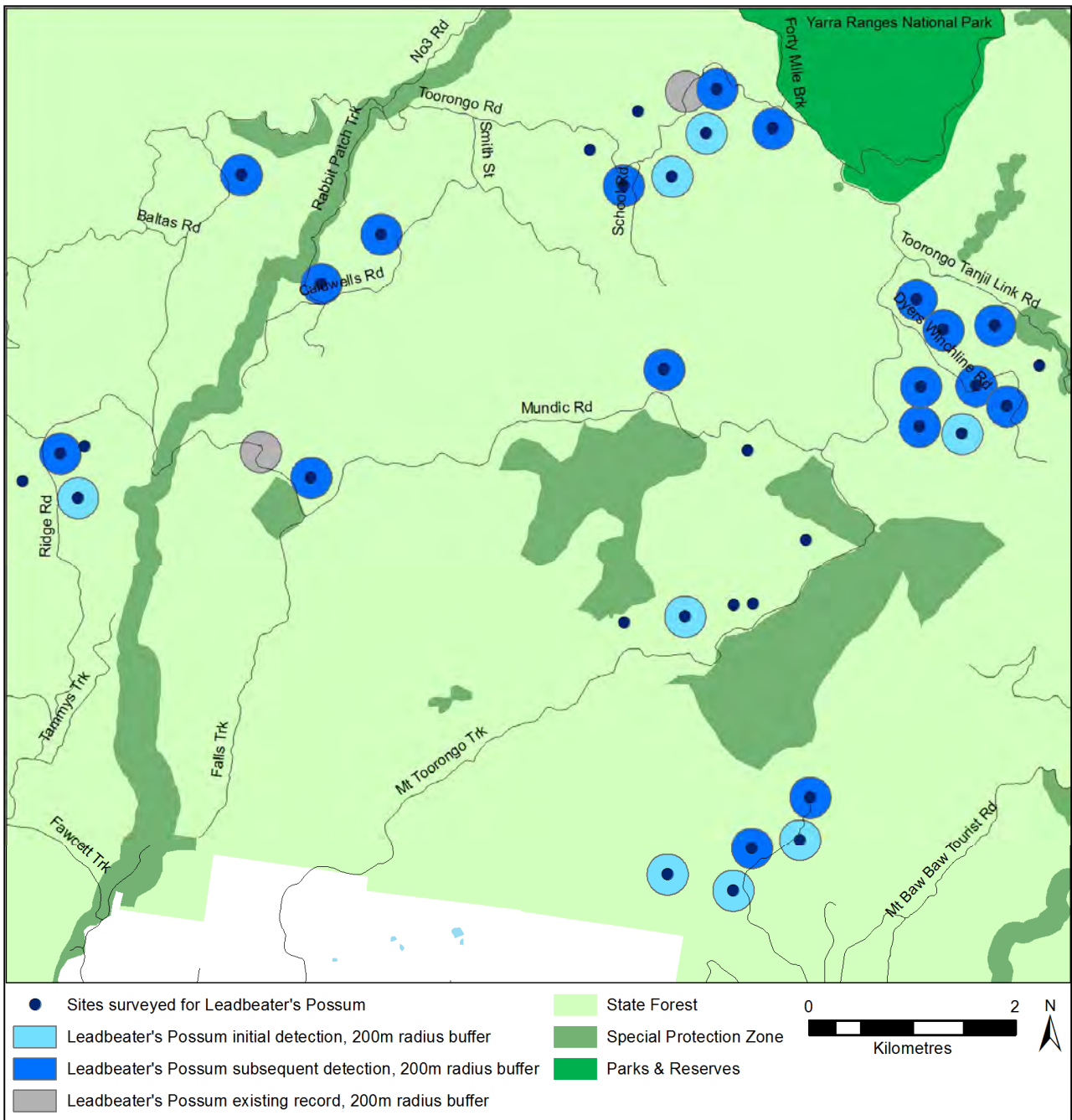
Leadbeater's Possum was recorded at a range of heights above the ground, from low in the understorey to high in the canopy (3 – 28 m above the ground, at an average height of 9 m). Although two camera traps were set at each site, Leadbeater's Possums were recorded on only one of the two cameras at 74% of the successful sites. They were detected by two cameras at 13 of the 50 sites.

To develop clusters of colonies for protection, 18 sites were surveyed in areas adjacent to Leadbeater's Possum records with existing 200 m timber harvesting exclusion zones, and a further 18 sites were surveyed adjacent to new records obtained during the surveys. In the Toorongo Plateau/Noojee area, for example, three main clusters of records were developed; one cluster of eight, and two clusters of five sites where Leadbeater's Possum was recorded (Figure 6). In the cluster that now comprises eight records, one site was initially surveyed in February 2015 in a patch of forest with greater than 65% probability of occupancy and, when successful, an additional four sites were then surveyed surrounding this site, all of which also produced records of the possum. Surveys of another four adjoining sites in April 2015 resulted in possum records from three of these sites. This resulted in Leadbeater's Possums being recorded at eight of the nine sites sampled in this area, leading to a combined timber harvesting exclusion zone of at least 113 ha. Overall, half of the 50 records of Leadbeater's Possum were from sites adjacent to either existing buffered records or new records obtained during the surveys, illustrating the efficacy of the approach used during the targeted surveys of sampling areas near existing records.

### 3.2 Occupancy model

Forty-three of the 65 potential sites delineated with greater than 65% probability of occupancy were surveyed for Leadbeater's Possum. An additional nine sites that initially targeted the greater than 65% category were relocated to new sites in the 50-65% category, due to access constraints (e.g. dense understorey vegetation, steep terrain, numerous fallen logs, resulting in target areas being too time consuming to reach) or to avoid unsuitable vegetation such as recently harvested areas. Leadbeater's Possums were detected at 49% of the high probability of occupancy sites and at similarly high proportion of sites in the 30-50% and 50-65% categories (Table 2); approximately half of the records obtained from the sites surveyed either adjacent to existing buffered records or to new records obtained during the surveys were in the 50-65% probability of occupancy category (Table 3). In contrast to the relatively high success rate in areas with greater than 30% probability of occupancy, the species was recorded at only 13% of sites sampled in areas with less than 30% predicted probability (Table 2).

Ten of the surveyed sites were in the category of greater than 65% probability of occupancy and also on the 2013-16 TRP where there is currently a timber harvesting moratorium. Leadbeater's Possum was detected at five of these 10 sites.



**Figure 6. Leadbeater's Possum survey sites and clusters of records in the Toorongo Plateau/Noojee survey area, November 2014 – May 2015.** Clusters of records were developed by surveying next to sites with existing buffered records (grey circles), and sites with new records obtained during the surveys (blue circles). Pale blue circles indicate new records initially obtained during the surveys, and darker blue circles are subsequent records obtained by surveying adjacent sites to form a cluster.

**Table 2. The number of sites surveyed for Leadbeater's Possum (LBP) in four categories of probability of occupancy (as predicted by occupancy modelling in Lumsden *et al.* 2013), and the number and proportion of detections in the Central Highlands, November 2014 – May 2015.** At 10 sites the two camera traps straddled boundaries of occupancy model categories. Where this occurred the site was assigned to a category based on which category occupied the greatest proportion of the area within 200 m of the centre of the site.

Predicted probability of occupancy	No. of sites	LBP detected	% of sites LBP detected
0-30%	15	2	13
30-50%	16	9	56
50-65%	39	18	46
65-100%	43	21	49
<b>Total</b>	<b>113</b>	<b>50</b>	<b>44</b>

**Table 3. Leadbeater's Possum (LBP) detections in different categories of modelled probability of occupancy for 36 sites surveyed either adjacent to existing buffered records or to new records obtained during the surveys.**

Predicted probability of occupancy	No. of sites	LBP detected
0-30%	1	1
30-50%	10	6
50-65%	18	13
65-100%	7	5
<b>Total</b>	<b>36</b>	<b>25</b>

### 3.3 Forest age

Sites were surveyed in forest stands ranging in age from 15 to 76 years and included logging regrowth, 1983 bushfire regrowth and 1939 bushfire regrowth. Ecotones between different-aged forests were often sampled to target areas where Leadbeater's Possums had access to both younger forest for foraging and older forest for nesting. At some sites this resulted in the two camera traps being set in different age-classes of forest, and hence the results are presented by camera rather than by site (Table 4). The highest proportion of Leadbeater's Possum records, based on where they forage rather than where they nest, were from regrowth forest 15 to 36 years after timber harvesting, with regrowth from bushfires in 1983 and 1939 also used regularly (Table 4).

Of the total 113 surveyed sites, 42 were in areas designated for timber harvesting under the 2013-2016 Timber Release Plan (Table 5). Leadbeater's Possum was detected at 15 of these sites (36%). Four of the sites where the species was detected were scheduled to be harvested by clearfelling, while 11 were scheduled for thinning (Table 5). Timber harvesting exclusion zones have now been established and harvesting will not occur within these areas.

**Table 4. The age-classes of forest surveyed using camera traps and the proportion of these where Leadbeater's Possum (LBP) was detected in the Central Highlands, November 2014 – May 2015.** Each site was surveyed with two camera traps, that sometimes sampled more than one age-class of forest, so the data is presented based on cameras not sites. Although Leadbeater's Possum was detected at 50 sites overall, it was recorded by two cameras at 13 sites, and hence by a total of 63 cameras.

Disturbance history	Stand age (years)	No. of cameras	No. of LBP detections	% of cameras with LBP detections
1939 bushfire regrowth	76	114	28	25
1960-1977 logging regrowth	38-55	19	3	16
1983 bushfire regrowth	32	33	9	27
1978-2000 logging regrowth	15-36	60	23	38
<b>Total</b>		<b>226</b>	<b>63</b>	

**Table 5. Sites surveyed for Leadbeater's Possum on the 2013-2016 Timber Release Plan (TRP), the method of harvesting and the proportion of sites where Leadbeater's Possum (LBP) was detected in the Central Highlands, November 2014 – May 2015.**

Harvest treatment	No. of sites	LBP detected	% LBP detections
Sites on the TRP - clearfelling	18	4	22
Sites on the TRP - thinning	24	11	46
Sites not on the TRP	71	35	49
<b>Total</b>	<b>113</b>	<b>50</b>	

## 4 Discussion

### 4.1 Survey results

In the first year of the Leadbeater's Possum targeted surveys, the species was detected at 50 of the 113 (44%) sites surveyed between November 2014 and May 2015. Half of the detections were from sites adjacent to other records; either existing buffered records or new survey records. While detecting the possums at more than 40% of sites is encouraging, it is important to note that survey sites actively targeted predicted high quality habitat and areas close to where the possum is known to occur. Therefore these results cannot be extrapolated to determine the likely proportion of occupied sites throughout the species' range – i.e. Leadbeater's Possum will not occur in 44% of the whole Central Highlands area.

It is not possible to determine numbers of individuals from camera trapping data as individuals cannot be recognised from the photographs. Although occasionally more than one Leadbeater's Possum was captured in the photographs, in general colony sizes cannot be determined. In addition, as the site selection was particularly targeted to areas where Leadbeater's Possum was most likely to occur, the data cannot be extrapolated across the species' whole range to estimate total population numbers.

Camera trapping is now widely used to survey terrestrial mammals (Meek *et al.* 2014). However, it has only recently been used in surveys for Leadbeater's Possum, with sites installed up to 4 m above the ground using ladders (Harley *et al.* 2014). In contrast, by using tree canopy specialists we were able to install cameras up to 36 m above the ground and target the vegetation layer most likely to be used by the possum at any particular site. This enabled much greater flexibility to sample in all forest age classes regardless of the vegetation structure. As a result, it was possible to select sites that were most likely to contain colonies of Leadbeater's Possum, and within each site, position camera traps where they had the highest chance of detecting animals moving within their home range.

Although Leadbeater's Possum was detected at 44% of sites, it is likely that the species was present on some sites but was not recorded during the surveys. Two camera traps were installed at each site; however, the possum was recorded by both cameras at only 13 of the 50 sites (26%) at which they were recorded. Camera traps were generally separated by 100 m so it is possible that at some sites one of the camera traps may have been outside the resident possums' home range, with the adjacent area not occupied. Camera traps detect Leadbeater's Possums when they are moving through the forest or foraging. Recent observations from camera traps suggest that the possums use particular pathways to move around their home range and forage in specific areas (ARI, unpublished data); unless camera traps are located along these pathways, resident animals may go undetected. Placement of camera traps within survey sites could therefore be critical to maximise the likelihood of detecting any possums present. Different habitat structure within a site may also greatly influence the likelihood of detecting resident possums. For example, possums may be easier to detect in gullies with dense mid-storey vegetation that provides narrow movement corridors than in more-open forest stands where movement pathways are more difficult to predict.

No survey technique is guaranteed to record the target species within an occupied site every time a survey is undertaken, and so it is important to understand how readily the species of interest can be detected, to interpret the findings of a survey. To date no analyses have been conducted to estimate the probability of detecting Leadbeater's Possum when using camera traps high in trees. Such analyses can assess the likelihood of false negatives (i.e. incorrectly concluding that a target species is absent) and provide a guide to the survey effort required for a high probability of detection. Preliminary analyses of the data from the 2014-15 surveys suggest that the probability of detecting Leadbeater's Possum on occupied sites with two cameras over a 21 day sampling period may vary from 0.53 to 0.79 depending on the model of camera used (three models of Reconyx cameras were used during these surveys). In addition to the variation due to camera model, there is a high level of uncertainty around the estimates with 95% confidence intervals indicating detectability could be as low as 0.34 or as high as 0.93. These preliminary analyses, however, suggest that by using this technique there is likely to be greater than a 70% probability of detecting



Leadbeater's Possums where they are present, although this figure could be lower or higher. These data will be analysed further as additional sites are surveyed to reduce the uncertainty of the estimates. However, the initial results indicate that increasing the number of camera traps at each site is warranted to increase the likelihood of detecting resident possums, although this needs to be balanced against the extra time it will take to install and retrieve equipment at each site, and hence the overall number of sites sampled. As a result of these preliminary analyses, three camera traps will be set at each site during targeted surveys in 2015-2016, to increase the likelihood of detecting resident Leadbeater's Possums. For the targeted surveys, where the aim is to record the species at as many locations as possible, it is believed that this is the appropriate balance between having a reasonable probability of detection, while still enabling a large number of sites to be sampled across the species' distribution. At this level of survey effort, however, it is likely that there will still be some sites where the species is present but not detected. For surveys that aim to have a high level of confidence that the species is absent if not recorded, a higher sampling intensity may be required.

## 4.2 Effectiveness of the occupancy model

A key requirement of these surveys was to target areas predicted as having a high probability of occupancy (i.e. greater than 65%) based on the models in Lumsden *et al.* (2013), particularly those sites on the 2013-2016 Timber Release Plan that are currently under the timber harvesting moratorium. Due to the inaccessibility of much of the high probability areas, more sites than initially planned were surveyed in the lower probability areas and outside the TRP. However, Leadbeater's Possum was detected at similar proportions of sites in the greater than 65%, 50-65% and 30-50% probability of occupancy categories with only the 0-30% category returning few records. Most of the sites in the 30-50% and 50-65% categories where the possum was detected were near existing records, which is likely to have influenced the higher than expected success rate.

The occupancy model was developed using broad-scale survey data collected by ARI in 2012 (Lumsden *et al.* 2013), and predicts current strongholds for the species based on the probability of occupancy across the species' range. Important site-level predictors of the presence and abundance of Leadbeater's Possum, such as hollow-bearing trees, mid-layer connectivity and availability of wattle (*Acacia* spp.) (Lindenmayer *et al.*, 1991a, 2013; Smith and Lindenmayer 1988, 1992, ARI unpublished data) could not be incorporated into the spatial version of the model as these variables have not yet been developed as spatial data layers across the species' Central Highlands range. Further work is currently being undertaken as part of the broader Leadbeater's Possum project (D. Adams, DELWP, pers. comm.) to map these critical habitat features which can then be incorporated into the occupancy model to improve its predictive capability. Despite the existing model not being able to factor in these habitat features, results from the targeted surveys indicate that the model is a useful predictor of where Leadbeater's Possums are likely to occur, although other features, like the presence of existing colonies nearby are also useful predictors.

## 4.3 Forest age

Leadbeater's Possum was detected across all age-classes of forest surveyed, with a similar proportion of records from 1939 and 1983 fire regrowth (25% and 27% of cameras respectively), with a higher proportion of detections in regrowth forest from timber harvesting between 1978-2000 (38% of cameras). The high stem density of regenerating forest stands provides the dense structure required by the possums for movement, and the presence of wattle provides *Acacia* gum for foraging (Smith 1984a). However, whether colonies are able to use such stands depends on the presence of hollow-bearing trees that are critical for nesting and diurnal shelter (Smith and Lindenmayer 1988, Lindenmayer *et al.* 1991b), either within the stand, or nearby. Leadbeater's Possum colonies occur in small, exclusive home ranges of 1 – 3 ha that are actively defended from neighbouring colonies (Smith 1984b). The small size of Leadbeater's Possums' home range, its active defence from neighbouring colonies, and the requirement for hollow-bearing trees for denning, mean that extensive areas of regrowth forest with few hollow-bearing trees are unlikely to provide suitable habitat for the species.

In contrast to other techniques, such as stagwatching, camera trapping does not provide information on where animals are denning, merely their movement or foraging pathways. Therefore, when interpreting results from this survey method it is important to consider the broader context surrounding the sites where the species was recorded. Where animals are nesting and how far they move to forage in these younger forests is a key knowledge gap. The habitat assessments currently being undertaken at each site, together with an aerial survey of large old trees (D. Adams, DELWP pers. comm.) and tracking of individuals using GPS collars (L. McBurney, Australian National University, pers. comm.) will provide important information to assist in the interpretation of how the animals are using these younger stands.

#### 4.4 Timber release plan

A total of 42 sites were surveyed that were scheduled for harvesting on the 2013-2016 Timber Release Plan. Leadbeater's Possum was detected at 36% of these sites. These areas were then immediately protected from timber harvesting by the creation of a 200 m radius timber harvesting exclusion zone. This result highlights the importance of undertaking surveys for colonies of Leadbeater's Possums before coupes are harvested, to provide increased protection of existing colonies and support the species' recovery.

#### 4.5 Future directions

In April 2015, the Victorian government announced that targeted surveys for Leadbeater's Possum will be fast-tracked to accelerate the identification of new colonies, so that these colonies can be protected more quickly than originally planned. These surveys will follow the same approach as those undertaken in 2014-15 with the refinement of three camera traps rather than two set at each site, to increase the probability of detecting the species where it occurs. Despite this increase in time required, other efficiencies gained from technique development and refinements plus additional resources for undertaking targeted surveys, will result in a greater number of sites being sampled in 2015-16, with 180 sites expected to be surveyed. All remaining areas of greater than 65% probability of occupancy that can feasibly be accessed will be surveyed during 2015-16.

Sampling will be undertaken across the species' range (with the exception of areas severely burnt in 2009 as these are unlikely to yet contain habitat suitable for the species). This will likely ensure that protection zones are located in a number of different areas, thus spreading the risk if future bushfires occur in parts of the species' range. Clusters of exclusion zones will continue to be developed, where possible, to provide protection for larger numbers of colonies, thereby increasing the long-term persistence prospects of colonies in these areas.

Detailed habitat collection will be undertaken at all sites sampled during the first two years of the targeted surveys, and these data will assist in refining understanding of foraging habitat. Detection probability analysis and occupancy modelling will be undertaken to improve predictions of the distribution and habitat requirements of Leadbeater's Possum to inform future management.



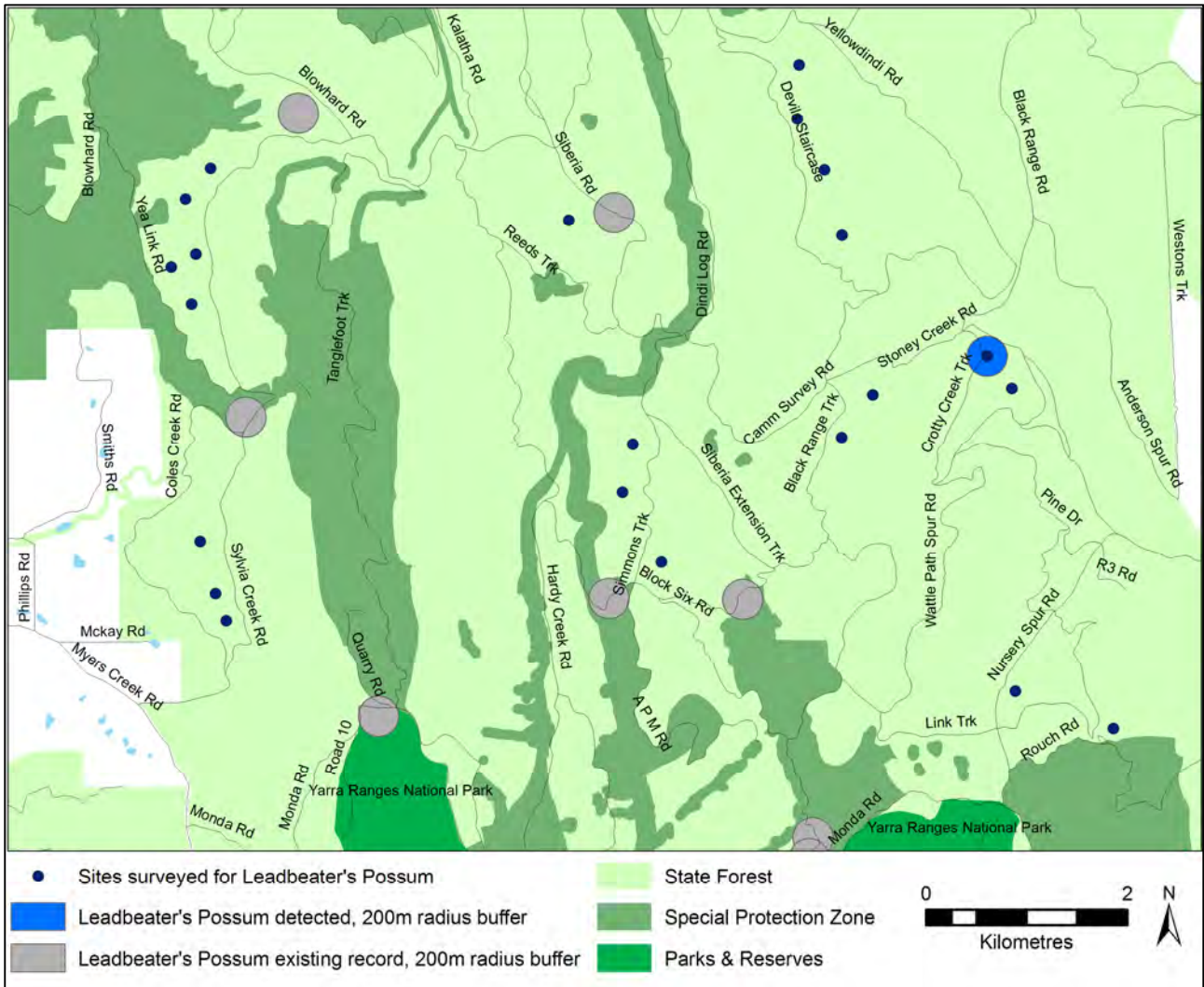
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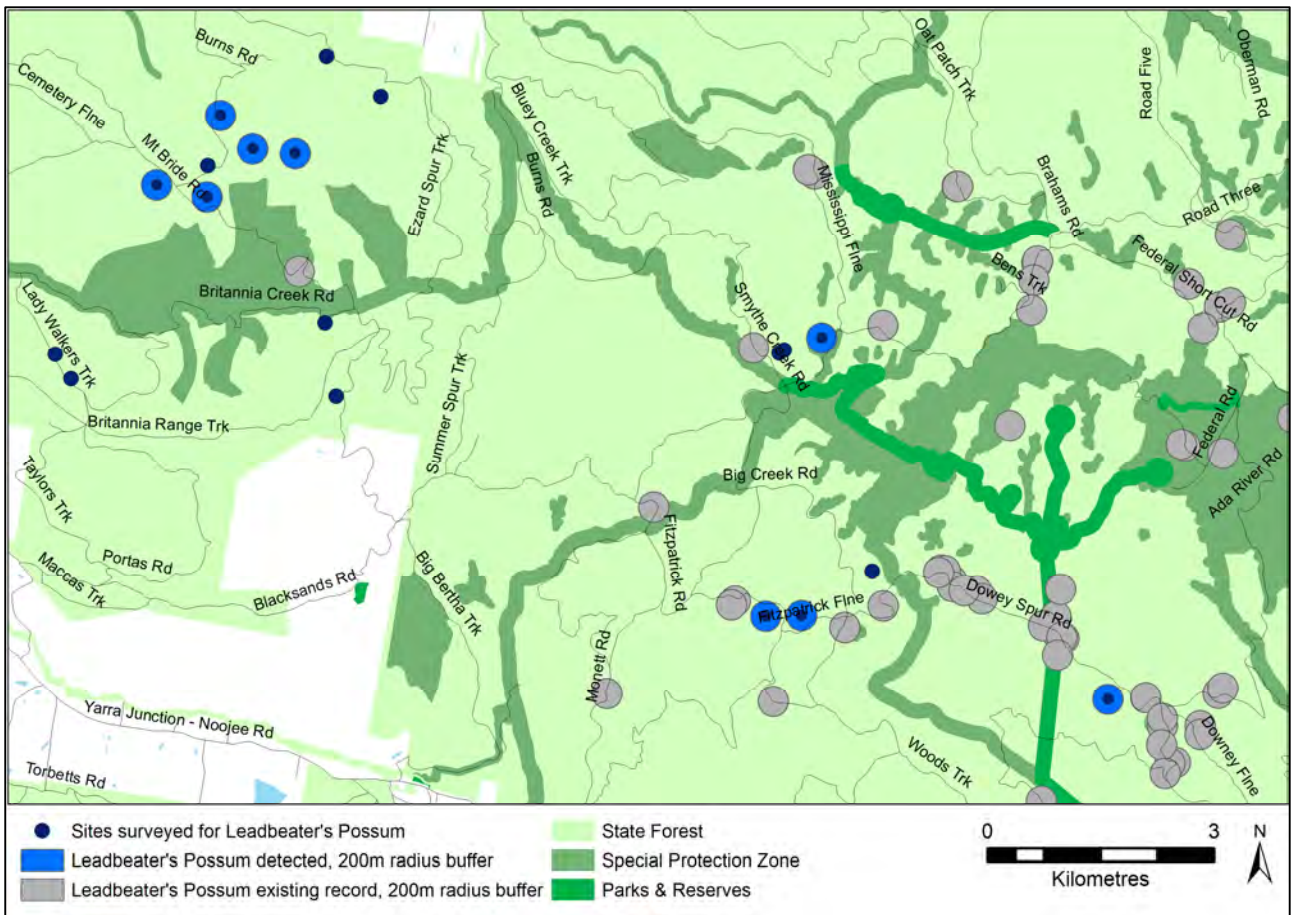
## Appendices

### Appendix 1 – The main sampling areas surveyed for Leadbeater's Possum in the Central Highlands in November 2014 – May 2015.

Refer to Figure 6 for a detailed map of the Toorongo Plateau/Noojee area.

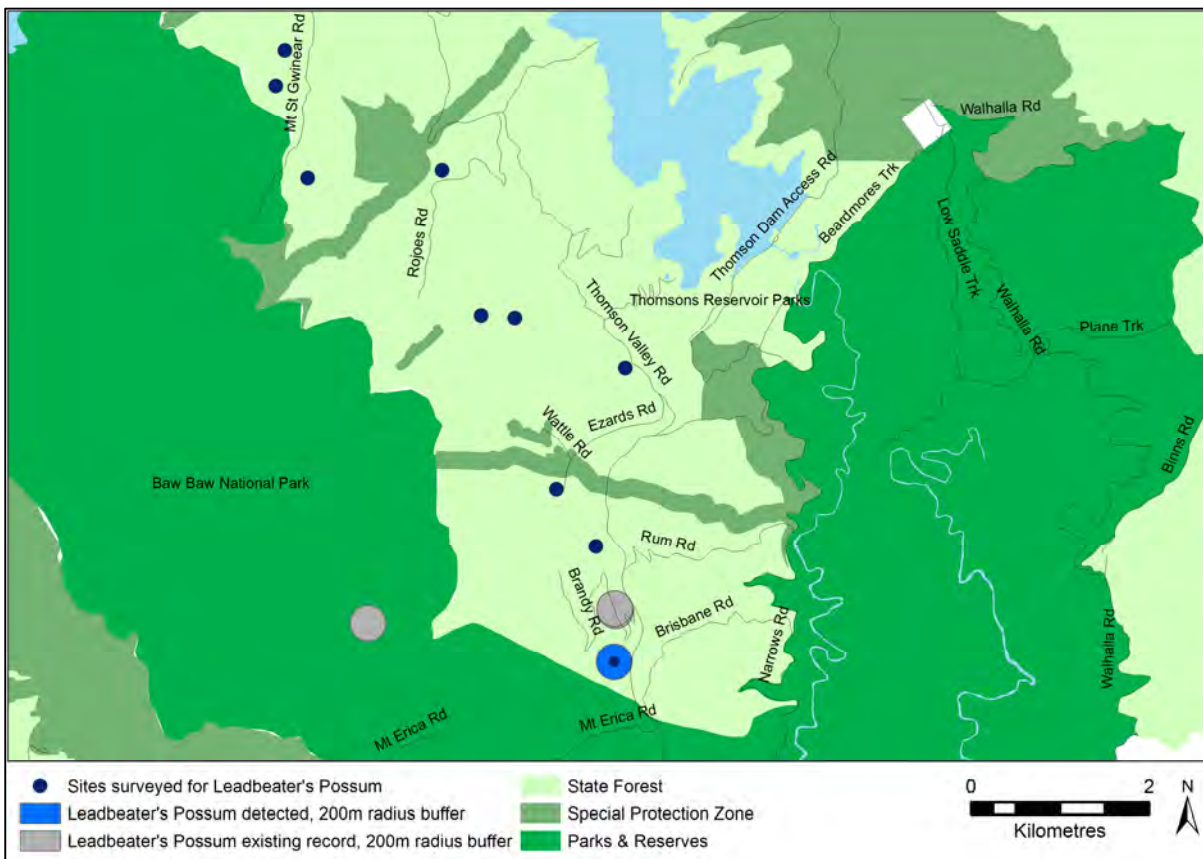
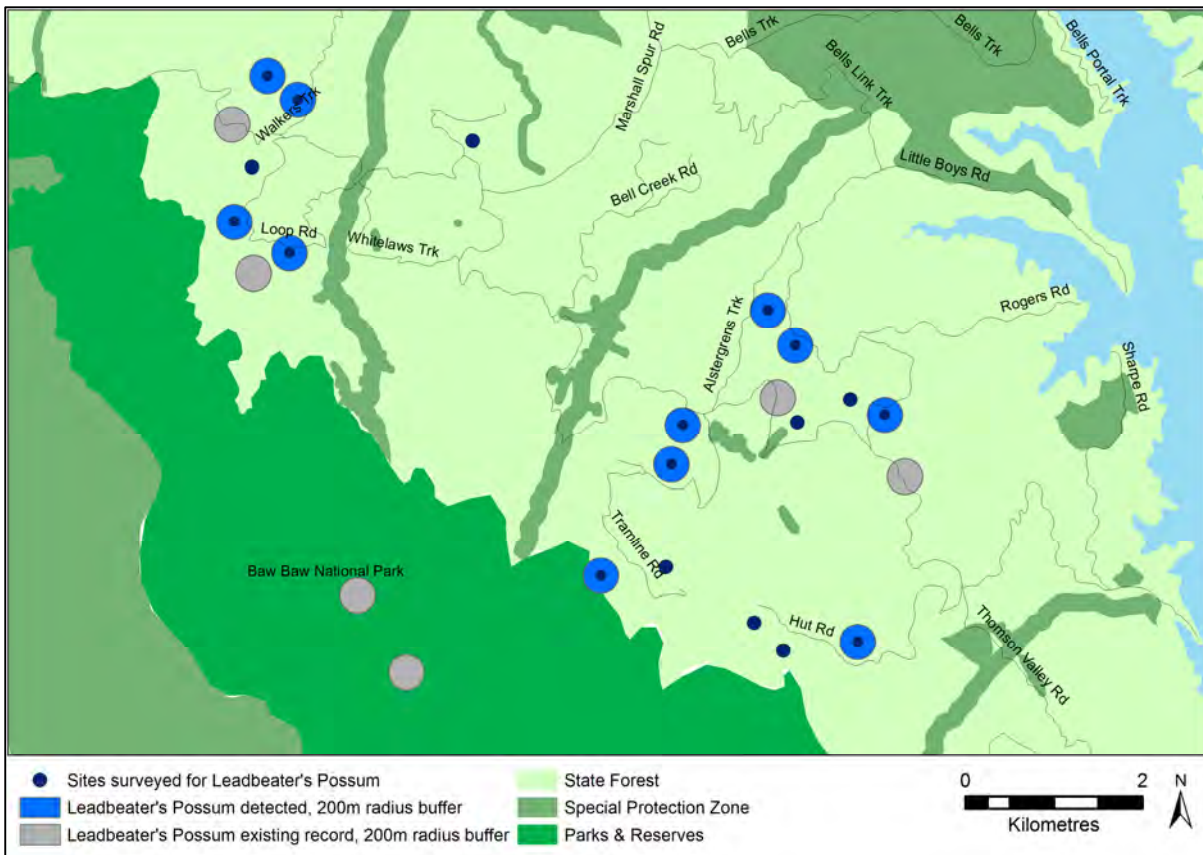


**a) Leadbeater's Possum records and survey sites in the Toolangi area.** Survey sites are represented by the dark dots, with sites where Leadbeater's Possum was recorded indicated by the blue 200 m timber harvesting exclusion zone. Existing records from the past 15 years with their 200 m exclusion zones are shown as grey circles.

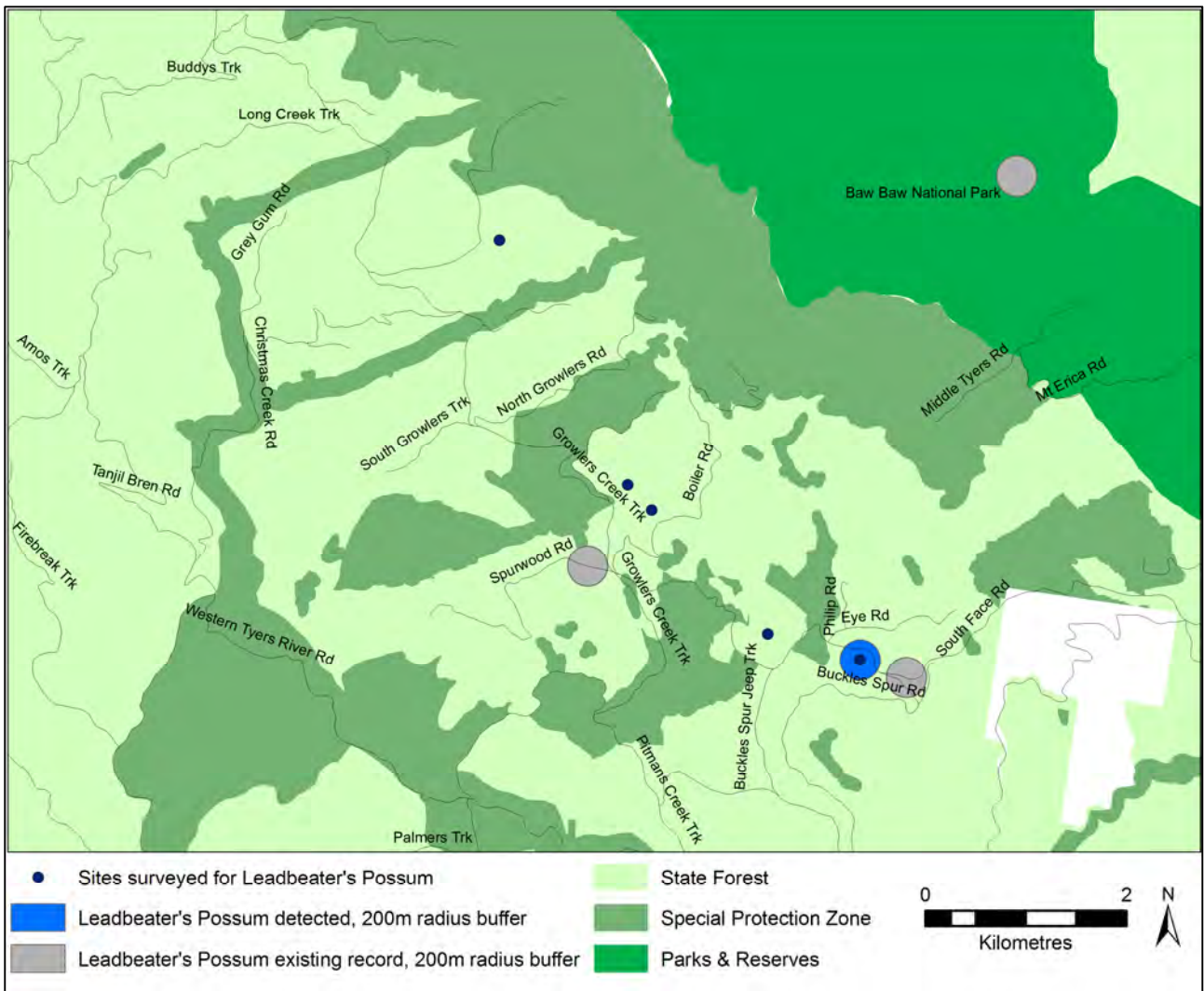


**b) Leadbeater's Possum records and survey sites in the Warburton/Powelltown area.** Survey sites are represented by the dark dots, with sites where Leadbeater's Possum was recorded indicated by the blue 200 m timber harvesting exclusion zone. Existing records from the past 15 years with their 200 m exclusion zones are shown as grey circles.





**c) Leadbeater's Possum records and survey sites in the Thomson State Forest to the east of Baw Baw National Park.** Survey sites are represented by the dark dots, with sites where Leadbeater's Possum was recorded indicated by the blue 200 m timber harvesting exclusion zone. Existing records from the past 15 years with their 200 m exclusion zones are shown as grey circles.



**d) Leadbeater's Possum records and survey sites in the area south of Baw Baw National Park.** Survey sites are represented by the dark dots, with sites where Leadbeater's Possum was recorded indicated by the blue 200 m timber harvesting exclusion zone. Existing records from the past 15 years with their 200 m exclusion zones are shown as grey circles.

## Appendix 2 – Photos recorded during the targeted surveys

Example of interactions between species captured during the targeted surveys: a Mountain Brushtail Possum *Trichosurus cunninghami* interacting with a Leadbeater's Possum.



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