The Leadbeater's Possum Review

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Preamble

This document reviews current science on Leadbeater's Possum and its montane ash forest habitat in the Central Highlands of Victoria.

The report comprises seven chapters on key topics related to the conservation and current management of Leadbeater's Possum and the forest habitats on which the species depends. Chapter 1 gives a brief history of major events that effect Leadbeater's Possum and its forest habitat in the Central Highlands of Victoria. Chapter 2 explores work on hollow-bearing trees, as they are the most critical habitat element that will dictate the species' survival. Chapter 3 reviews some of the recent policies for the management of the species, while Chapters 4 and 5 provide a summary of some of the statistics and other information relating to Leadbeater's Possum and the forests in which it is found. Chapter 6 explores information about and insights into the Mountain Ash ecosystem and why it is currently classified as Critically Endangered under IUCN Red List of Ecosystems criteria. Chapter 7 reviews many relevant government documents. Chapter 8 contains some general conclusions about the management of Leadbeater's Possum and the forests in which it occurs.

Throughout this report, unless otherwise specified, reference to ANU means the ANU scientists who have conducted research in the Victorian Central Highlands ecosystem over the past 34+ years, or the scientific work that they have produced.

We examine the threats to Leadbeater's Possum as well as critically appraise the effectiveness of management actions and protective measures designed to conserve the species. We examine the Critically Endangered listing of both Leadbeater's Possum and the Mountain Ash ecosystem in which it lives, and why both are in a parlous state. The review looks back over the history of decisions and other factors that have led us to the current situation, and explores possible futures based on decisions currently being made.

Our review relies heavily on the substantial scientific literature on Leadbeater's Possum and Mountain Ash forest. Long term data and scientifically robust research will play an important role in rigorously assessing many current claims about the status of populations of Leadbeater's Possum and its habitat and providing clarity on information to guide enhanced decision making.

The area of remaining 1939 age forest in the Central Highlands is reaching low levels, and important decisions need to be made about how the forests of this age are managed. The next 5-10 years will be critical for how the Central Highlands ash forests and the species that inhabit them persist (or otherwise) over the next century.

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Acronyms

ACF	Australian Conservation Foundation
ANU	The Australian National University
AP	Australian Paper
ARI	Arthur Rylah Institute for Environmental Research
AS	Action Statement (FFG)
ASH	Australian Sustainable Hardwood
CFMEU	Construction, Forestry, Mining and Energy Union
CH	Central Highlands
DBH	Diameter at Breast Height
DELWP	Department of Environment, Land, Water and Planning
DEPI	Department of Environment and Primary Industries (now DELWP)
DSE	Department of Sustainability and Environment (now DELWP)
EPBC	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
ENGO	Environmental Non-Government Organisation
FFG	*Flora and Fauna Guarantee Act 1988* (Victorian)
FLBP	Friends of Leadbeater's Possum
FMA	Forest Management Area
GIS	Geographic Information System (for mapping)
HBT	Hollow-bearing tree
LBP	Leadbeater's Possum
LMU	Leadbeater's Possum Management Unit
LPAG	Leadbeater's Possum Advisory Group
ME	MyEnvironment (ENGO)
OG	Old growth
PV	Parks Victoria
PVA	Population Viability Analysis
RFA	Regional Forest Agreement
RT	(Leadbeater's Possum) Recovery Team
SPZ	Special Protection Zone
THEZ	Timber Harvesting Exclusion Zone
TSSC	Threatened Species Scientific Committee
TWS	The Wilderness Society
VAFI	Victorian Association of Forest Industries
VBA	Victorian Biodiversity Atlas
VEAC	Victorian Environmental Assessment Council
VF	VicForests

Glossary

Ash: See Montane Ash.

Central Highlands: Forested area east of Melbourne including the Maroondah, O'Shannassy and Upper Yarra catchments and Toolangi, Rubicon, Marysville, Powelltown and Noojee State forest areas. Generally the area covered by the Victorian Central Highlands Regional Forest Agreement.

Clearfelling: A silvicultural method of harvesting a coupe whereby all merchantable trees, apart from those to be retained for wildlife habitat, are removed.

Code (of Practices): Code of Forest Practices for Timber Harvesting Operations 2014 [1].

Coupe: A specific area of State forest identified for the purposes of a timber harvesting operation in a timber release plan, or on private land a single area of forest or plantation of variable size, shape and orientation from which timber is harvested in one operation [1]. **Gross coupe area** is the total area inclusive of harvesting exclusions within the planning boundary. **Net coupe area** is the total area that will be cut, i.e. total area minus harvesting exclusions.

Department: The Victorian State Government Department of Environment, Land, Water and Planning (DELWP), previously Department of Environment and Primary Industries, Department of Sustainability and Environment

Hollow-bearing tree: Any tree, live or dead, that contains a hollow of any shape or size [2].

Home range / territory: Area in which a colony of possums will forage, den and defend.

Leadbeater's Possum Reserve: Area of 30,500 ha reserved for Leadbeater's Possum conservation in 2008.

Montane Ash: Refers to forests with dominant overstorey of Mountain Ash, Alpine Ash or Shining Gum.

Regional Forest Agreement: (RFA) A 20 year agreement between State and Commonwealth governments that had an aim to deliver sustainable timber production and comprehensive, adequate and representational reserves to conserve biodiversity. The Central Highlands RFA expires in 2018.

Thinning: Removal of a proportion of the standing trees within a forest. The aim is to improve growth of the remaining trees. Thinning often results in damage to the mid and ground storey.

Timber Harvesting Exclusion Zone: (THEZ) A 200m radius SPZ buffer that excludes harvesting in order to protect a place where a verified sighting of Leadbeater's Possum has occurred.

Salvage logging: Logging of trees that have died following a major disturbance such as a bushfire.

Special Protection Zone: (SPZ) Areas of State forest managed for conservation; harvesting is excluded.

Variable Retention Harvesting: (VR) A silvicultural system where islands of undisturbed forest are retained within the cutover area of a logging coupe. The benefits include acting as refugia for flora and fauna that are damaged or lost due to mechanical disturbance during logging operations, as well as the retention of overstorey trees that can continue to mature to old growth stages.

Mountain Ash forest (Photo: D. Blair)

Executive summary

Leadbeater's Possum and its primary forest habitat, the Mountain Ash forests of the Central Highlands of Victoria, are both Critically Endangered. Populations of hollow-bearing trees, the key habitat resource for Leadbeater's Possum, are in rapid decline and with them, Leadbeater's Possum is also declining.

The forests of the Central Highlands are one of the most fire-prone environments on Earth but also home to some of the world's tallest trees. **Chapter 1** describes the long history of fires and intensive human forest use of this region. It describes how a possum believed to be extinct is rediscovered and becomes the faunal emblem of the state and a 'test case for sustainable forestry'.

The ecological resilience of this forest ecosystem is derived, in part, from old trees. **Chapter 2** shows that current conservation measures for Leadbeater's Possum protect only the very best habitat, but other areas of potentially suitable habitat are likely to be critical to the long-term persistence of the species. Current prescriptions such as the protection of Zone 1A and 1B classified forest and the protection of 5ha+ patches of old growth are insufficient for the long-term conservation of the species. The majority of hollow-bearing trees are **not** covered by these prescriptions, yet the protection of every remaining hollow-bearing tree is critical [3]. The retention and recruitment of hollow-bearing trees is **the** single most important issue for managing Leadbeater's Possum (and many other threatened species). Current logging and regeneration prescriptions do not provide adequate protection for existing hollow-bearing trees to prevent them from being burnt, wind thrown or otherwise damaged. Logging prescriptions lack landscape context, often fragmenting existing habitat, with few or no links between reserves and future habitat. Between 1997 and 2015 over 40% of hollow-bearing trees were lost, and in young regrowth the rate of collapse was even higher at 57%. In the same period, the signs of climate change were evident with 14% of unburnt live old trees dying – trees that should have lived another hundred years.

In **Chapter 3** we examine the damage that has occurred to efforts to conserve Leadbeater's Possum since the Leadbeater's Possum Advisory Group (LPAG) began influencing policy. The Recovery Team (comprising all experts on Leadbeater's Possum) was excluded from LPAG, while non-experts from government and industry developed a highly compromised set of recommendations. For the first time, the recovery of a threatened species was tied directly to the maintenance of an extractive industry. The recommendations advised pursuing a range of actions based on unproven recovery measures, while prescriptions likely to be effective in protecting hollow-bearing trees were ignored. Following LPAG, the Department drafted wide ranging documents relating to Leadbeater's Possum management, including a new Flora and Fauna Guarantee Act Action Statement, which did not reflect the latest peer-reviewed science and contained many changes that make it more difficult to protect Leadbeater's Possum. LPAG was followed by the Forest Industry Taskforce which agreed the status quo was bad for both industry and the environment, but failed to agree on key actions and a path forward. Publicly available information on the forest industry has become increasingly opaque and difficult to extract specific detail from. The Commonwealth Government's Leadbeater's Possum Management Team produced a scientifically sound document which recommended protection of hollow-bearing trees and an expanded reserve.

Recent increases in Leadbeater's Possum sightings have led to many claims of population recovery. In **Chapter 4** we discuss the importance of population trends compared to estimates of total population size. Long-term data clearly indicate the population is in decline – a fact on which all Leadbeater's Possum experts agree. It is highly likely that the recent spike in Leadbeater's Possum sightings is due to a huge increase in survey effort, triggered by the introduction of buffers around

verified sightings. With careful interpretation, these additional sightings may assist in achieving more accurate population figures, but these sightings are also being used to make a range of unsubstantiated claims about population size. Most importantly, many of the recently found colonies of Leadbeater's Possum are unlikely to be there in a decade due to ongoing habitat decline, particularly the rapid decline in hollow-bearing trees.

The average age of Mountain Ash forest is younger than at any stage in the history of this ecosystem and the impacts of climate change are already being felt. **Chapter 5** collates the figures from the forests and the timber industry. These figures show if LPAG's targets of reestablishing 30% old growth are to be met, then logging of the 1939 age forest must stop immediately. Buffers around Leadbeater's Possum colonies affect a relatively limited amount of forest (<5,000 ha) compared to forecasts of future loss due to fire (17,400 ha) and climate change (70,000+ ha). Declining sawlog yield means that continued extensive logging will be largely only for pulp to meet contractual agreements for pulpwood that have not been reduced in line with sawlog yield. Ecologically damaging thinning operations are likely to increase.

Chapter 6 examines the Critically Endangered listing of the Mountain Ash ecosystem. While the overall area of ash has not diminished, the key structures and abiotic processes that allow it to sustain current diversity are under threat from fire, logging and climate change (and an interaction between all three). Based on assessments using IUCN Red List of Ecosystems criteria, the Mountain Ash ecosystem has a ≥92% likelihood of 'ecosystem collapse' within 50 years.

Chapter 7 reviews several recent government documents. We found the general level of scientific rigour was not strong and the statistics and underlying assumptions used within many models were often poor. Additionally, retrograde steps in conservation efforts were prevalent in many documents making protection of Leadbeater's Possum more difficult. The 'pre-1900' protection of old trees needs updating to either be age-based (e.g. 100 years) or DBH-based (e.g. 1.2m DBH) assessments. The occupancy model developed by the Department for Leadbeater's Possum is a useful general indicator of possible Leadbeater's Possum presence, but is being used uncritically by a wide range of government and non-government stakeholders and without acknowledgment of its major limitations or assumptions. The majority of science conducted by State Government departments and on Leadbeater's Possum, and the resulting reports, generally lacks peer review.

The VEAC fibre and wood supply review predicted major structural change in the forest industry as harvesting of the 1939 age forests decreases due to the limited remaining available areas of this forest age class. The effect of this reduction in sawlog availability is now being felt. The reduction is a result of several decades of harvesting high levels of yield from this resource and losses due to the 2009 bushfires. Recent additional protection for Leadbeater's Possum has had a relatively minor impact. The report also found that under the modelled climate change impacts (3^{o}C by 2080), 80% of the ash forests would no longer be able to self-perpetuate, but rather than express concern about ecosystem collapse, the report concluded that hand planting seedlings may be the solution. Finally, the recent review of the THEZ buffers provides strong claims of reducing extinction risk. This is concerning as it is based on models that assume no fire for the next 200 years, and on buffers whose adequacy to protect Leadbeater's Possum, even in the short term, is completely unknown. The review places great emphasis on total population while largely ignoring the more important trend in population, which is in decline. We have a concern that considerable effort will be directed towards trying to obtain better total population estimates and that the lack of this information will delay necessary key management action. The THEZ review does not address how additional hollow-bearing trees are to be recruited.

In **conclusion**, it appears recent sightings are clouding the view of the future of both Leadbeater's Possum and its Mountain Ash habitat. Despite intense survey efforts in the last 3 years finding several hundred possums, this does not in any way alter the well-established population trend that has been declining over the last 20 years. Many current populations of Leadbeater's Possum, having just been found, will no longer exist within a few years due to continuing high rates of collapse of hollow-bearing trees, as has been occurring across these forests for many years.

Mountain Ash forests have so much to offer in terms of tourism, abundant clean water, carbon storage, recreational opportunities and biodiversity, but with past logging and fires, they have been modified to a point where their resilience is significantly impaired and their future ability to cope with ongoing logging, further fires and an altered climate is very much in doubt.

Leadbeater's Possum (Photo: S. Kuiter)

Leadbeater's Possum (Photo: S. Kuiter)

Chapter 1: Brief history of Leadbeater's Possum *Gymnobelideus leadbeateri*

Key points

- Victoria's Central Highlands forests are some of the best studied forest ecosystems in Australia with Leadbeater's Possum one of the most intensely researched animals of conservation concern globally.
- The forests of the Central Highlands have a long history of gold mining, timber harvesting and water production dating back over 150 years.
- The area is one of the most fire prone environments in the world; several high severity bushfires in the Central Highlands in the last century.
- The conservation of Leadbeater's Possum is as a 'test case for sustainable forest management', but the Critically Endangered status of the species indicates forest management is not currently ecologically sustainable.
- Captive breeding of Leadbeater's Possum was successfully managed in the 1980s but current efforts over the last 6 years are yet to be successful.
- Major efforts have been made through LPAG and the Taskforce to sustain the native forest timber industry while protecting Leadbeater's Possum but durable solutions have been elusive and the species continues to decline.

The management of Leadbeater's Possum has a long history (Table 1.1). As one of Victoria's faunal emblems and being considered a 'test case for sustainable forest management' [4,5], Leadbeater's Possum has been the focus of much research, many reports and substantial management effort. Many events have punctuated the history of discovery, management and conservation of Leadbeater's Possum. Despite this, populations of the species have declined in the last decade due to diminishing habitat quality and the collapse of suitable den trees.

Table 1.1. Brief timeline of significant events relating to Leadbeater's Possum

1867	Leadbeater's Possum (LBP) discovered, SW Gippsland
1876	Watts (Maroondah) catchment reserved for water supply [6]
1888	Upper Yarra water catchment reserved for water supply
1889	O'Shannassy water catchment reserved for water supply
1905	Bushfire
1907	Victorian *Forests Act 1907*, widespread sawmills and gold mining
1926	Bushfire
1927	Maroondah Dam completed
1939	Black Friday bushfires, 85% of CH burnt, LBP assumed to be extinct
1952	Salvage logging from 1939 fires completed
1961	Rediscovery of LBP between Marysville and Cambarville, 3 April by Eric Wilkinson
1971	LBP declared Victorian State faunal emblem
1972	Des Hackett successfully breeds the first LBPs in captivity (in his backyard in Blackburn)
1978	Andrew Smith conducts PhD research at Cambarville on LBPs, 1978 - 1980
1983	Ash Wednesday bushfire, burns forest in the Powelltown area
1983	David Lindenmayer begins research under direction of Andrew Smith at the University of New England
1985	Melbourne Zoo and Healesville Sanctuary successfully breeding LBPs in captivity
1986	Des Hackett closes his breeding enclosures, Taronga Zoo distributes animals to zoos overseas

1987	Departments of Conservation Forests and Lands, and Fisheries and Wildlife allow a single trial release of captive LBPs into the wild, 12 animals at 4 sites. Fate of animals largely unknown; one animal survived 20 days without weight loss. For many years, the Department refuses further release trials despite zoos with many 'surplus' animals [7].
1988	Malcom Macfarlane studies LBP use of nest boxes
1988	Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act), LBP listed as a threatened species
1991	LBP Zone 1A prescriptions published [8] based on conditions and data from the 1980s
1994	LBP listed as Endangered by IUCN Red List
1995	LBP Action Statement (under FFG Act) published
1995	Yarra Ranges National Park declared, covers over 20% of known LBP distribution
1996	Premier Jeff Kennett signs Victorian *Forests (Wood Pulp Agreement) Act 1996* which guarantees pulp supply to the Maryvale Mill until 2030 from the Central Highlands
1997	There are 41 sawmills and 4 major pulp mills receiving hardwood resources from the Central Highlands [9]
1998	Central Highlands Forest Management Plan released, 'pre-1900' trees protected
1998	Central Highlands RFA signed, State and Commonwealth agreement
2001	LBP listed as Endangered (EN) under Commonwealth Environment Protection and Biodiversity Conservation Act 1999
2003	'Variable Retention roundtable', Marysville; ANU and VicForests begin VR trial [10]
2004	Commencement of Victorian Sustainable Forests (Timber) Act 2004
2004	Friends of LBP group formed, push to reconvene Recovery Team and update LBP Action Statement
2006	LBP Recovery Team convene, group includes all LBP experts from universities, zoos, ENGOs and DSE
2008	Green Carbon report finds Mountain Ash forest one of most carbon dense globally [11]
2008	LBP Reserve declared
2009	Black Saturday bushfires burn Toolangi, Marysville State Forest, Maroondah, O'Shannassy water catchments and Lake Mountain; 43% of LBP reserve burnt, no LBPs found in burnt areas
2010	Last captive Leadbeater's Possum in the world dies in Toronto zoo (Canada)
2010	Action Statement completed by Recovery Team, never formalised by government
2011	Leadbeater's Possums brought into captivity (Healesville Sanctuary) from Lake Mountain after colony that had survived 2009 fire began being predated by a cat. Animals brought in from Yellingbo to begin lowland LBP breeding program.
2012	*MyEnvironment v VicForests* court case regarding logging of LBP habitat
2012	LPAG convened, initiated by Coalition State Government; no external LBP experts, no ENGOs. Industry and government group, produces report with 13 recommendations
2014	LBP survey standards, maturity assessment of ash, Action Statement documents adopted
2014	200m THEZ buffer to protect known locations of LBPs introduced (LPAG recommendation 1)
2014	VR harvesting introduced to 50% of ash coupes (LPAG recommendation 3)
2015	Forest Industry Taskforce, initiated by Labor State Government, includes forest industry and ENGOs, investigates 11 key areas for the forest industry and conservation
2015	LBP 'uplisted' from Endangered (EN) to Critically Endangered (CR) on advice from Threatened Species Scientific Committee [12]
2015	Mountain Ash forest ecosystem listed as CR by the IUCN Red List of Ecosystems
2015	Since 1997, 41% of hollow-bearing trees have collapsed in the CH ash forests
2016	Environmental Accounts for Central Highlands forests first report [13]
2017	There are 7 saw mills in the Central Highlands
2017	DELWP review of effectiveness and impact of establishing THEZ around LBP colonies [2]
2017	Environmental Accounts for Central Highlands forests updated report [14]
2017	Breeding program for lowland LBPs at Healesville Sanctuary thus far unsuccessful; 21 animals brought in of which 8 have died in the 6 years since program began
2018	Victorian Central Highlands Regional Forest Agreement expires, June
2024	The last of all current ash sawlog contracts from the Central Highlands expires
2030	Australian Paper contract expires

Chapter 2: Hollow-bearing trees – a critical habitat resource

Key points

- Retention and recruitment of hollow-bearing trees is the most important issue for management of Leadbeater's Possum.
- Hollow-bearing trees (HBTs) are a critical nesting resource for over 40 vertebrate species in the ash forests including owls, parrots, bats, possums, gliders, reptiles and small mammals.
- HBTs are usually a minimum of 120+ years old. Both live and dead forms of HBTs are important for different species.
- HBTs are in decline across the Central Highlands ash forests. HBTs are most abundant in old growth forest stands, which now comprise only1% of the landscape. The "next old growth" (and therefore next HBT cohort) will come from the 1939 cohort of trees.
- HBTs are the best predictor of possum and glider abundance. Currently there is no GIS layer for HBTs available.
- THEZ buffers are likely to be more effective if placed around HBTs than sighting locations.

On our research sites:

- 41% of hollow-bearing trees collapsed between 1997 and 2015 [15].
- In young regrowth forests, the collapse rate of HBTs was 57%. In 1939 age forest, 53% of HBTs collapsed between 1997 and 2015 [15].
- Large old trees have declined from an average of 7 per hectare in 1998 to 3 in 2011.
- On sites burned in 2009, 79% of live hollow-bearing trees died.
- On sites burned in 2009, 57-100% of large old dead trees were destroyed.
- On unburned sites, 14% of live old trees died between 1997 and 2011 (highest proportion between 2006-2009) [16], trees that should have survived at least another 100+ years.
- Our research sites are not subject to logging. In logged areas, it has been found that on average 70% of hollow-bearing trees are lost [13].

Large old trees with hollows fulfil a vitally important ecological function in forests around the world, but unfortunately they are also in decline on a global scale [17]. In the ash forests of the Central Highlands, hollow-bearing trees which provide a denning resource for a wide range of species, including possums, gliders, birds, bats, small mammals, reptiles and insects are in rapid decline. Trees are being lost due to fire, logging, fire break creation, drought, storms and climate change.

For Leadbeater's Possum to recover, long term management must focus on the retention and recruitment of hollow-bearing trees. Nothing else is more important. Current buffering (THEZs) around confirmed sightings is providing some protection to the Leadbeater's Possum population from logging and will be slowing the rate of decline. But the **Leadbeater's Possum population is still in decline, a trend that is likely to continue for another 50 years due to declining populations of hollow trees** [18] (for modelled decline of Leadbeater's Possum, see Figures 4.2 and 4.3 in Chapter 4). It is likely the THEZ buffers would be more effective in the longer term if placed around all HBTs.

Protection for hollow-bearing trees is currently inadequate, with ongoing losses due to logging and fire. Even without logging and fire, losses are significant. Between 1997 and 2011, we recorded the death of 14% of large old trees on our unburnt long-term research sites [16]. The majority of

these were during the final 3 years of the 'millennium drought', early signs that our warming climate is having an effect on trees that have been alive for 150-300 years (and which should have lived almost as long again). On our research sites, 41% of HBTs collapsed between 1997 and 2015. Importantly, this has not been offset by sufficient recruitment of new HBTs because the majority of the landscape is now characterised by young logging regrowth and fire regrowth that will not form hollows for many decades.

Many recent Leadbeater's Possum detections have been in young regrowth forest (<40years old), but only in regrowth where sufficient old hollow-bearing trees have been retained. However, **the future for the majority of these recently found colonies is highly uncertain due to ongoing losses of hollow-bearing trees**. Many of these sites already have very low numbers of HBTs and previous research has shown the rate of collapse of HBTs is most rapid in this age class, with losses of 57% from 1997–2015 (this included sites burnt in 2009). This compares with 16% for forests of old growth age [15].

In the montane ash forests of the Central Highlands, **hollow development is a slow process** [19]. Because of the lack of animals that actively create hollows (like woodpeckers), hollows form by rot and termites entering trees, usually through wounds – broken branches, side scars, broken tops and fire scars [20]. This process is possible in ash prior to senescence (as ARI found with their 'form 0.5' HBTs [2]), but is far more common in the larger older senescing ash and it is in these trees that cavities tend to be of more suitable size for possums [21]. A large trunk diameter is often a good indicator of likely internal cavities [19]. However, if a tree has grown rapidly to that size (for example due to thinning), there may still have been insufficient time for the decay process to develop suitable cavities [22]. Because the cavity recruitment process is so slow, it is imperative that the cohort of trees closest to senescing age be preserved and protected. Currently that cohort is **the regrowth from the 1939 fires, which is the 'next old growth' in this landscape**. At an age of 78 years, the 1939 age forests are well on the way towards becoming old growth when compared to the majority of the remainder of forest that is currently less than 20 years old. However, trees of this age group are currently filling the majority of sawlog contracts, resulting in direct conflict for this resource, that is, whether to continue to log it to maintain the native forest industry, or protect and allow it to grow old, with the alternative values that would bring.

Chapter 3: Leadbeater's Possum Advisory Group, Forest Industry Taskforce, Recovery Team and Leadbeater's Possum Management Team: updates

Key points

- The Leadbeater's Possum Advisory Group (LPAG) was established in 2012 to promote efforts to conserve Leadbeater's Possum.
- The terms of reference for LPAG, '*support recovery of LBP while maintaining a sustainable timber industry*', linked possum recovery to the health of the timber industry and made it impossible to consider some key conservation actions (such as protecting old trees and expanding the reserve system). This resulted in a number of ineffective or unproven actions being recommended and adopted because the major proviso was that they could not negatively affect the timber industry.
- LPAG lacked participation by independent experts and ENGOs.
- The LPAG recommendation to buffer known colonies with a Timber Harvesting Exclusion Zone (THEZ) is the most effective action to come from the process.
- Buffering (THEZ) around verified sightings has led to the increase in new records due to greatly increased field survey effort over the last 3 years.
- Following LPAG, DEPI and VicForests drafted a broad series of documents relating to Leadbeater's Possum management without consulting independent experts, including a new LBP Action Statement. Few of LPAG's recommendations were based on peer reviewed science. Subsequent citation of these documents has given them an undeserved legitimacy and they continue to have a lasting negative impact on the conservation of Leadbeater's Possum.
- LPAG recommendations have diverted limited funds and attention to less important actions such as trials to create artificial hollows, while existing hollow-bearing trees are not mapped and continue to be lost due to lack of protection.
- The Forest Industry Taskforce was established in 2015, and its aim was to integrate viewpoints on forest management and Leadbeater's Possum from a range of stakeholder perspectives.
- The Forest Industry Taskforce, after early initial agreement on broad problems, failed to agree on key forest management actions.
- The National Recovery Plan for Leadbeater's Possum (written by the Australian Government's Leadbeater's Possum Management Team) is a more detailed and scientifically sound document than the 2014 Action Statement and recommends an expanded reserve and protection of HBTs amongst many other recommendations.

Leadbeater's Possum Advisory Group (LPAG)

LPAG was convened in 2012. LPAG consisted of representatives from the timber industry and industry support groups, the Department of Environment and Primary Industries, and Zoos Victoria (but not their LBP expert). LPAG lacked input from independent experts on Leadbeater's Possum and ENGOs, who declined to be involved due to the limited terms of reference and concerns about the legitimacy of the process associated with LPAG.

LPAG's report [23] was released in April 2014, and contained 13 recommendations. We have reviewed this document as it has largely dictated government action on Leadbeater's Possum since its publication, despite being written by a forest industry favourable group that lacked expertise on the species under review.

The process for developing protective measures for Threatened species is usually a 3 step process.

1. **Experts** on the species advise on a range of options for protecting the species, rating them on effectiveness;
2. **Affected industries and stakeholders** discuss the impacts different options would have on them;
3. **Government makes decisions**, weighing up the needs of the species, obligations under relevant legislation, and impacts on stakeholders.

The **LPAG process attempted to roll all three steps into one**, with a restrictive term of reference of "*Support the recovery of Leadbeater's Possum while maintaining a sustainable timber industry*." To the best of our collective knowledge, this is the first time in Australia that the recovery of a Threatened species had been tied directly to the health of the extractive industry that was threatening it.

Timber industry representatives were willing to accept only a 5% total reduction in yield resulting from all of the final LPAG recommendations. The resulting recommendations were severely constrained by the terms of reference with several key options, including protection for individual old trees and an expanded ecological reserve [24], unable to be considered. Instead, a focus was on actions that would not reduce timber availability, many of which were unproven and unlikely to be effective. This was despite the technical report for LPAG [25] and an ARI report [26] showing an expanded reserve was (and still remains) the most effective way to protect Leadbeater's Possum.

Unfortunately for the industry, the impacts of Recommendation 1 (buffering known colonies, see below) were underestimated when modelled during LPAG. As we know now (see Chapter 7), the change in prescriptions resulted in driving a substantial survey effort, leading to several hundred verified records. Despite this being the most effective action to come out of LPAG, it is quite possible that along with other known effective measures (buffering all HBTs and an expanded ecological reserve), this measure also may not have been considered if it had been correctly modelled at the time. This highlights the compromised nature of the LPAG process where **the most effective protective measures require additional forest reserves** [26,27], **but it is these measures which the terms of reference specifically excluded from consideration**. Chapters 4 and 7 discuss the perceived and actual impact the THEZ buffers have had and how this has resulted in the industry calling for buffer reductions and a downlisting of the species' conservation status.

LPAG recommendation 1 – protect LBP colonies

Aim: *Provide protection to all known and newly discovered colonies of Leadbeater's Possum.*

- Establish 200m Timber Harvesting Exclusion Zones (THEZ) around verified sightings, focus of a major review [2] (see Chapter 7 – for a broader discussion).
- Acknowledgment made in the report "it is unknown how effective a 200m buffer will be for long term persistence". The limited current science suggests buffer is likely to be too small [18,28].

Conclusion: *Buffering known colonies is a positive initiative that was long overdue. The 200m buffers are, however, likely to be too small to ensure the persistence of Leadbeater's Possum. See detailed review in Chapter 7.*

LPAG recommendation 2 – delay harvesting in areas of anticipated high probability of occupancy

Aim: *To minimise the risk of harvesting in areas with high probability of Leadbeater's Possum occurrence.*

- Avoid harvesting areas modelled to have >65% probability of LBP presence, based on ARI occupancy modelling [18], 83% of this area is already in parks and reserves.
- Harvesting exclusion lasted 2 years (and expired April 2016).
- No precautionary principle applied with areas up to 65% likely to have LBP still logged.
- Field tests of the occupancy model showed the areas modelled with 35-65% likely presence of LBPs were equally likely to have LBPs present as areas listed as >65% likely (see Chapter 7).

Conclusions: *Very limited effect due to choice of highest probability category. 'Protection' only for 2 years and based on model without strong habitat-based variables.*

LPAG recommendation 3 – transition to retention harvesting (or 'Variable Retention' harvesting)

Aim: *Transition away from widespread clear-felling to more environmentally sensitive retention harvesting to maintain structures such as existing hollow-bearing trees, retain areas of intact forest and retain live trees that can grow to become old trees.*

- From July 2014, 50% of coupes were to be Variable Retention (VR) with increase to 100% 'if operationally achievable'.
- VR has been shown to be 'operationally achievable' in Victoria [29] and Tasmania [30] during the past 10+ years and has been used successfully internationally for over 25 years [31].
- Jan 2017 Timber Release Plan in the CH listed 376 clearfell ash coupes but just 26 VR coupes [32].
- VicForests 2017 Resource Outlook appears to have no intention of raising the proportion of VR harvesting above 50%.
- Retained islands being burnt during regeneration burns (thereby killing retained trees) continues to be a problem [33].
- The introduction of VR requires an overall reduction in sustained yield (to account for retained islands), otherwise there is a perverse outcome of a broader area being affected by logging.
- Due to very long term nature of VR, its benefits for Leadbeater's Possum is currently unknown. However birds and small mammals show an improved response relative to clearfell logging [29,34].

ANU established trials for Variable Retention harvesting in 2003 in conjunction with DSE/VicForests [35]. ANU was assigned the task of monitoring the effects on wildlife and plant communities, which it did, and VicForests was supposed to monitor the effects from a harvesting and timber yield point of view. The general reluctance by VicForests to adopt VR since these trials began is symptomatic of the broader resistance to change to more ecologically sustainable forest management practices.

Conclusions: *The reluctance by VicForests to adopt incremental improvements in more ecologically sustainable management practices is concerning. The benefits of VR are very long term. If such practices had been more broadly implemented 15 years ago, they may have made a difference to current conservation outcomes in Mountain Ash forests. VR must be accompanied by a reduction in sustained yield, otherwise the impacts of logging are spread over a greater area, leading to perverse outcomes for biodiversity. Undisturbed areas within VR operations (i.e. retained islands within coupes) are likely to benefit possums/gliders, small mammals, birds and plant biodiversity.*

LPAG recommendation 4 – revised regeneration practices

Aim: *To reduce the risk of damage to habitat from high intensity regeneration burns.*

- The most critical habitat elements being damaged by regeneration burns are hollow-bearing trees (HBTs).
- HBTs have a critical habitat role for many vertebrate species [22].
- HBTs are generally 150+ years old, and are very difficult to replace.
- The logging and regeneration process can damage HBTs by them being cut down or knocked over during logging, burned during regeneration burns, and through wind damage post-logging due to the surrounding forest no longer providing protection. Buffers provide a small island of intact habitat for fauna at the time of logging.
- Live HBTs are often killed, taking decades off their life as a useable hollow tree.
- Dead HBTs are destroyed in even the lightest severity burns.
- Artificial hollows are expensive to create across wide areas.
- Prescriptions recommended by ANU [24] suggested a 100m buffer around hollow-bearing trees due to their key functional role and difficulty in replacement. This could be an alternative THEZ.

Conclusions: *Burning more carefully around HBTs would be an improvement on past practices, but is still an inadequate response and does not overcome loss through damage by logging machinery, wind storms or competition with regrowth [16]; buffering with areas of unlogged forest is required. HBTs are of critical ecological importance, are very difficult to replace, and currently have poor protection through the Code of Practices. Buffering HBTs is one of the highest priorities for conserving Leadbeater's Possum [24], yet could not be considered by LPAG due to limitations in the terms of reference. Given the vulnerability and importance of large old trees, it is difficult to reconcile the ongoing loss of these 150+ year old biological legacies through the logging and regeneration process while progressing with expensive and inferior alternative strategies like the attempted creation of artificial hollows (see below). There has been knowledge of the ongoing rapid decline in numbers of large old trees for many years [36-38]. Despite this, DELWP has initiated few reforms to logging practices to improve the protection of HBTs.*

LPAG recommendation 5 – buffer old growth

Aim: *To minimise risk to modelled old growth in current prescriptions by establishing a buffer around these old growth stands.*

- By current definition, to qualify as old growth, the area of old trees must be greater than 5ha in size. Such areas are now very rare in the State Forests.
- Old growth patches are to be protected with a 100m buffer.
- 'Stages of growth' documents (2014) redefined old growth as being 250+ years old, more than 100 years older than previously defined (see Chapter 7).
- Protection of smaller patches and individual old growth trees remains inadequate (see Recommendation 4, above).
- In the Central Highlands, old growth trees rarely grow as even age stands, but more commonly are part of a mixed age stand with younger cohorts [39] making it less likely to be classified as pure old growth.

Conclusions: *The protection of hollow-bearing trees is clearly inadequate. All large old trees need urgent protection, not just those in the exceptionally rare old growth stands that are greater than 5ha. Due to the quality and range of natural hollows that old trees provide, it is preferable that effort be directed to protecting these trees rather than the building of nest boxes (Recommendation 9) or creation of artificial hollows (Recommendation 10). Between 1997 and 2015 ANU measured a 41%*

decrease in populations of hollow-bearing trees, lost due to fire, logging, climate change and natural attrition (storms, rot and decay) [15].

LPAG recommendation 6 – amend the definition of LBP Zone 1A

Aim: *To protect HBTs to increase the chance of retaining suitable habitat for Leadbeater's Possum.*

- Zone 1A was developed as possums were difficult to detect, so were protected by protecting the best quality habitat.
- The concept of "Zone 1A and 1B" was developed in the late 1980s/early 90s [8].
- The zoning was adopted in the 1995 Action Statement, Zone 1A related to forest with live HBTs; Zone 1B related to forest with living and dead HBTs.
- Zoning is technical and difficult to apply. The government currently does not know the size of LBP Zone 1 reserve. Between 2012 and 2016 Zone 1 protected 193ha (compared to 4000+ ha for THEZ over the same period) [2].
- A strong positive correlation exists between the number of HBTs on a site and the likelihood of occurrence of all possum species [33,36,40].
- In the 1995 Action Statement [41], Zone 1A was "mature ash forest (>120 years old)", or "regrowth ash forest with **at least 12** live HBTs per 3ha" (i.e. 12 or more).
- This LPAG recommendation changed this to "**more than 10** live trees".
- In 2013, ANU re-ran the original modelling (possum occupancy against HBT numbers) that created the 1995 '12 or more live trees' and found, due to severe deterioration of the HBT resource over that time, if 1A was created in the same way now, it would be '**8 live or dead trees** /3ha'. As the density of HBTs in the forest continues to decline over the next decade, to achieve the same benchmark, the number of trees per 3ha should continue to reduce.
- Following the *MyEnvironment v VicForests* court case (2012), new survey standards with 'clarifications' to the definition of Zone 1A and 1B were introduced in 2013 [42]. These standards were written by the Department without consultation with external experts. A range of measures were introduced, many of which make it more difficult to protect Leadbeater's Possum habitat, including:
    - The definition of a 'mature' tree was changed so all 1939 regrowth is now excluded.
    - Live trees must have "enough foliage to keep them alive".
    - Dead trees must be self-supporting. While not common, there are sound HBTs that lean on other trees and have remained standing for many years. Leaning against another tree does not diminish their function as a suitable den tree.
    - HBTs must be 6m to 30m tall despite LBPs being known to use shorter and taller HBTs.
    - Dead trees must be >1.5m DBH. In Alpine Ash, LBP regularly use smaller DBH trees.
    - HBTs must not be more than 100m apart. Radio tracking of LBPs found average distance between den trees to be 135m and movements up to 600m were recorded [43], Zone 1A was previously calculated just based on area.
    - Basal area of wattle now to be calculated at each tree and averaged. The original Action Statement wording only specified the need for $5m^2$ of wattle within 3ha.
    - HBTs must be >100m from the "edge of survey area" but the new Action Statement does not define what this means. If this excludes HBTs outside the coupe boundary, for example in gully areas where HBTs are often found, this will make reaching the required tree density to achieve 1A exceedingly unlikely. Trees outside the coupe boundary were previously allowable (as occurred in the court case).
    - A 10m buffer must be drawn around the HBTs being considered, with the buffer included as part of 3ha, thus making it much harder to achieve required density. Previously the

3ha polygon was drawn from tree centre to tree centre. Due to this new rule, approximately 22-30% of the 3ha polygon is now required to be HBT free.

- The combination of new conditions has made it significantly harder to protect LBP habitat than was the case in 1995.
- LBP experts (including the ANU researchers) were not consulted when the new survey standards [42] were written and new restrictions do not appear to have been based on existing science or well established protocols.
- The new Survey Standards were published without author attribution nor disclosure of who approved them.

Conclusions: *Changes have made it less likely that high quality LBP habitat will be conserved. There are so few large old trees remaining that the concept of zone 1A should become redundant. It is critical to protect all large old trees (live and dead), not just those in large groups or patches. It is no longer adequate to protect only small areas of the highest quality habitat.*

LPAG recommendation 7 – target future old growth ash forests for protection

Aim: *To ensure that at least 30% of ash forests are able to reach their oldest growth stage, thereby significantly increasing the proportion of old growth ash forests across the landscape.*

- Target aims to achieve "at least 30% of ash forest within each LBP Management Unit (LMU) be protected so that it can mature into old growth forest in the future".
- Target based on minimum level of old growth estimated to exist prior to European settlement; it has been estimated that 30-60% of ash forests were old growth [3].
- Currently approximately 1% of the ash forests of the Central Highlands is old growth [44].
- The 'next oldest' forest is the 78 year old 1939 cohort. These stands will begin to senesce in 50 years. The majority of the remainder of the ash forests will take more than 100 years to reach a stage where they first begin to develop cavities.
- The 1939 cohort currently covers approximately 30% of the State forest ash estate [45] and 1939 forest cover in some LMUs is already under 30%.
- The chances of a large scale fire reducing the current area covered by the 1939 cohort in the next 50 years is very high.
- Continued logging will ensure the 30% old growth target is unachievable for 100+ years
- Compared to young forest, old growth also increases water runoff [46], stores more carbon [47], is better for tourism and reduces fire severity [48].

Conclusions: *With only 1.16% of the ash forest estate currently old growth, and 30% of the forest estate being 1939 regrowth, if the old growth target is to be reached before the end of this century,* ***all remaining 1939 stands must be protected****. This is especially the case if modelling of increased fires and range contraction of Mountain Ash due to climate change occur [45]. Increasing the area of old growth also makes economic sense because it will result in an increase in water yield, carbon storage and a reduction in fire risk [13].*

LPAG recommendation 8 – fire management of known colonies and high quality habitat

Aim: *To increase the protection of Leadbeater's Possum colonies and habitat through fire planning and management, develop emergency responses.*

- Mapping known colonies and making this information available to all land managers is critical.
- Due to LBPs being fire sensitive, important to avoid burning areas with known colonies.
- Reduce fire risk in surrounding areas, including lower elevation forest by reducing fuel.
- Nearly all dead HBTs are lost during fire events of any severity and therefore fuel reduction burning should avoid such trees or provide adequate protection during burns.

Conclusions: *Care must be taken with the needs of other threatened species. Locations of LBPs should be based on known sightings, additional surveys and examining areas for suitable habitat, not solely based on the ARI occupancy modelling (see Chapter 7).*

LPAG recommendation 9 – install nest boxes

Aim: *To install nest boxes to support existing colonies in areas of declining natural tree hollows.*

- Artificial (recycled plastic) nest boxes to be installed to supplement natural hollows.
- Nest box installation provides good community engagement through 'Project possum' (Zoos Vic, FLBP, PV) with many boxes paid for by community members.
- Nest boxes have targeted sub-alpine Snow Gum and young ash regrowth where known colonies are and where next boxes have best results; 496 boxes were installed and there have been 'signs of occupancy' in an average of 53% of boxes (76% of boxes installed in unburnt sub-alpine woodland and 30% of boxes installed in the ash forests) [49].
- Rather than reporting the most optimistic (and not particularly useful) statistics on 'signs of occupancy' (which may be a few strips of bark from possums marking territory, but not actually occupying the den), it would be preferable if actual usage and nesting were reported, how many colonies were using boxes (as they are put up in groups of 4 around each colony), and in what habitat types they were being used.
- Nest boxes are not cost effective to install across the full range of Leadbeater's Possum habitat [18].
- A 10 year ANU study [50] found some success with next boxes in young regrowth ash forest (confirmed by ARI [49]), but very limited success in 60+ year old forests [51].
- The Yellingbo population of LBPs is still declining despite large numbers of nest boxes being installed.
- Nest boxes can have unintended detrimental consequences, such as allowing pest species to invade [52] and do not cater for the wide range of native species that require hollows. For example, the Greater Glider has never been recorded using nest boxes in the Central Highlands ash forests.

Conclusions: *Nest boxes are expensive and are not a long term economic or ecological solution. The use of nest boxes to supplement the declining number of natural hollow-bearing trees has been partially successful in the past at Yellingbo and in sub-alpine areas. However, the Yellingbo population continues to decline even though large numbers of nest boxes have been established in the reserve. Nest boxes have also had some success in young regrowth ash forests, but as these forests become older (60+ years), nest boxes are unlikely to continue to be effective.*

Reporting on nest box success has been overstated. Nest boxes have been placed in areas known to have high LBP density and reporting on any sign of use gives a distorted (and likely highly over-optimistic) view of actual use. Where reporting refers only to the number of nest boxes containing evidence of a visit and ignores multiple boxes used by a single colony (boxes are placed in groups of 4), this is also likely to lead to overestimates of the numbers of colonies occupying them. Nest boxes are expensive to build, install, monitor, maintain and replace, and may inadvertently introduce pest species. Protecting existing large old trees is of far greater ecological benefit.

LPAG recommendation 10 – accelerate hollow development

Aim: *To explore practices to expedite hollow development.*

- Silvicultural methods are used to accelerate hollow development (e.g. deliberately damage trees during thinning to create scars).
- Such silvicultural methods are likely to take many decades before any benefits are seen.

- One of the main silvicultural methods is thinning, but this is problematic as it damages the midstorey which is important for food and movement pathways. Thinning also may make forests more fire-prone [53,54].
- Trees that grow more quickly (due to thinning), do not necessarily develop hollows more quickly. Time is a critical ingredient to allow rot, fungi and insects to create internal cavities [17].
- Mechanical hollow development (chainsawing holes and fitting 'doors') creates hollows that are likely to be more resistant to damage from falling branches than nest boxes and therefore potentially last longer.
- 72 artificial hollows have been chainsawed into trees by arborists, 37 have 'signs of occupancy', although the actual level of use is not reported (see nest box discussion above) but this appears to be a positive development.
- Mechanical hollow development is likely to be expensive and is unproven in the long-term.

Conclusions: *ANU fully support trials of creating artificial hollows – it is new and interesting and appears to be having some success. However, as with nest boxes, the cost and effort is high and has diverted funding and attention away from the most critical action which is protecting all existing large old trees. This project has had a substantial amount of funding and we have concerns the data are being interpreted in an overly optimistic way and preventing appropriate protection of natural hollows in old trees which have proven success in supporting a wide range of species over millennia.*

LPAG recommendation 11 – translocation

Aim: *To assess the desirability and feasibility of translocating LBPs to establish new colonies in suitable but unoccupied habitat within the known range of the species.*

- Specifically looking at wild to wild translocations within the known LBP range.
- In future, there may be examination of translocation to areas outside known range [55].
- Translocation has many problems; the new area may not be suitable, there may be existing populations that 'push out' the new possums, depleting existing colonies may cause local collapse, LBPs are very sensitive to change and disturbance and disease may be introduced [56].
- Introducing a species to a totally new area (e.g. Tasmania) has a long history of problems [57].
- Failure of the Department to support trial releases of captive bred LBPs in the 1980s when large captive populations were available means knowledge is poor in this area [7].

Conclusions: *This recommendation is very high risk and unproven and as yet, has not been implemented. We note that translocations of Australian animals outside their known range can have significant detrimental impacts on other fauna. As an example, the translocation of Sugar Gliders from Victoria to Tasmania has triggered catastrophic declines of now highly endangered species such as the Swift Parrot [57].*

LPAG recommendation 12 – community engagement

Aim: *To engage more closely with industry, ENGOs, and community on activities that would lead directly to improved outcomes for Leadbeater's Possum.*

- The community has intense interest in LBPs and in-depth knowledge of the species. The Friends of LBP group has approximately 250 members. The conservation of LBPs is a very divisive political and social issue.
- There has been a long history of community members and experts wanting meaningful engagement, but an equally long history of government ignoring scientific advice and the Department being resistant to meaningful change. Examples include Des Hackett who spent

his life breeding LBPs for release only for those captive-bred individuals to be sold to zoos overseas; the Recovery Team writing an Action Statement in 2010 which was never signed off by the Minister; *MyEnvironment v VicForests* court case; LPAG with no independent LBP experts effectively replacing the Recovery Team which had all the experts; very late and minimalist adoption of variable retention harvesting; LBP survey standards that make it more difficult to protect the species; and using recent increased sightings to falsely claim population recovery.

Conclusions: *The local and Victorian communities are very engaged and well informed on this issue, but are very cautious about ongoing engagement due to the very long history of being ignored or the combative nature of dealings with the Department and VicForests. Despite this, for all processes except LPAG where the terms of reference and group membership skewed towards the timber industry, the community has continued to engage in a wide range of processes, giving freely of their time and expertise over many, many years, including thousands of hours of field surveying.*

LPAG recommendation 13 – monitor and review

Aim: To achieve adaptive management where the above 12 recommendations are monitored regularly and outcomes reviewed so as to achieve improved forest management.

- A review of the benefits and impacts of the 200m THEZ buffers has been completed [2].
- There is an intention to review all LPAG recommendations by 2018.
- 6 monthly reports were to be completed [49,58].
- Wide range of actions have been undertaken so far including many hours of field surveys.
- The aim is for adaptive management to be achieved, designed to improve management over time as information becomes available.
- Too much emphasis is being placed on estimating the total population size but ignoring population trends.
- Survey methods of camera traps and call playback are suitable for achieving high detection rates, but results are difficult to quantify, making interpretation for population estimates etc. problematic.
- Any consideration or review of the LPAG recommendations should be cognisant that the RFA review is due to report in July 2018.

Conclusions: *Some progress has been made and some important changes to forest practices have been implemented (buffering confirmed sightings, aiming for 30% old growth if it is implemented). However, reviews must have a broad perspective and recognise Leadbeater's Possum is a species in rapid decline, the key habitat resources for the species are in rapid decline and forest practices are failing to protect the single most crucial habitat feature – existing hollow-bearing trees. Current practices also fail to plan for the recruitment for new cohorts of hollow-bearing trees.*

Many LPAG recommendations focused on actions with negligible impact on sustained yield (nest boxes, artificial holes, translocation, Zone 1A changes) but the terms of reference constrained consideration of retention and recruitment of hollow-bearing trees, resulting in a set of recommendations that fell far short of what is required for the long-term conservation of Leadbeater's Possum.

Forest Industry Taskforce

The Taskforce was convened in mid-2015 and comprised representatives of the timber industry (ASH, AP, harvest and haul, VAFI), ENGOs (ACF, ME, TWS) and the timber union (CFMEU)). The primary purpose was to "*arrive at a set of long-term, durable recommendations and proposals for*

government concerning the future of Victorian forests, including industry dependent on the forest, jobs reliant on this industry, and the conservation of forest ecosystems and threatened species."

The Taskforce investigated 11 key areas of inquiry (plantations, parks and reserves, land use and access, industry analysis, fibre-based jobs and skills, ecosystem services carbon and water, regulation legislation and management, silvicultural systems, regional development other industries, threatened species and plant communities, and fire).

In September 2016, the Taskforce released a Statement of Intent, noting:

- Recognition that current 'business as usual' is not sustainable to either industry or ecosystems and there is a need for a new and different approach.
- Wood supply into the future is uncertain.
- Ecosystems are diminishing or declining.

Early common ground was found, including acknowledgement that additional or expanded reserves/parks were required for threatened species and that industry required secure wood and fibre supply. However, in late 2016, it became clear that consensus on how to achieve these outcomes was unlikely and that ultimately the government would need to make key decisions on how to best manage and protect the forest. To assist with wood and fibre supply, a $110M commitment was given to establishing new plantations.

There are on-going concerns regarding the decline of threatened species including LBP, Yellow-bellied Glider, Baw Baw Frog and the Greater Glider. Further concerns include the Australian Paper contract obligations to supply pulpwood and the impact this will have on the Central Highlands ash forests, the future of Australian Sustainable Hardwoods and other saw mills and the employment of workers, and the future of alternative development opportunities around the region.

During this process, the Victorian Environmental Assessment Council (VEAC) was commissioned to report on the Conservation Values of State Forests [59] and Fibre and Wood Supply [45,60], discussed below in Chapter 7.

Leadbeater's Possum Recovery Team

The Leadbeater's Possum Recovery Team was re-established in 2006, following requests from the Friends of Leadbeater's Possum community group that the out of date Action Statement for the species be updated.

The Recovery Team comprised all current LBP experts from within the Department, ANU, Friends of LBP, Field Naturalists Club and Zoos Victoria. Everyone who worked on or with LBPs was present. Following the 2009 fires, the Recovery Team was well aware of the increased risk to LBP due to the reduction in population and loss of habitat, and in 2010 the Team finalised an updated Action Statement. This new Action Statement was never signed off by the Minister. Following a lack of action from the Government, ANU resigned from the Recovery Team and it became largely dysfunctional.

In 2012 the Recovery Team was sidelined by LPAG. The only representative from the Recovery Team on LPAG was the Department chair, who was not a LBP expert, but rather convener of the meetings.

In 2013, the Recovery Team was given new terms of reference with the group split into a 'control board' comprising government employees and a 'working group' that had community members. The working group's role was reduced to being advisory only. When decisions were being made regarding uplisting Leadbeater's Possum to Critically Endangered, LPAG, not the Recovery Team was informing Government. The Recovery Team has not met for several years.

Leadbeater's Possum Management Team (Australian Government)

The Commonwealth Government's Leadbeater's Possum Management Team has also examined what is required for recovery of the Leadbeater's Possum. In February 2016, it released a Draft National Recovery Plan for Leadbeater's Possum [55]. **Written with input from external experts, the Draft National Recovery Plan is an excellent summary of current situation for Leadbeater's Possum**.

Given Leadbeater's Possum is a species endemic to Victoria, the National Recovery Plan and (State based) Action Statement have historically been identical. With the 2014 Action Statement [61] written following the LPAG recommendations, that is no longer the case.

The Draft National Recovery Plan details existing population estimates, outlines the major scientific findings on the species and proposes 8 Objectives with associated actions that it is hoped will lead to the recovery of the species. The objectives and actions outline below are copied directly from the plan (with some deletions of less important sections), the conclusions are our reflections on the objectives. See pp. 63-76 of the Plan for full details.

Objective 1: All relevant existing and future planning and policy settings are reviewed and where required, refined and implemented in a manner that contributes appropriately to maximising the chances of long-term survival of Leadbeater's Possum in nature.

Rationale: *Management actions alone will not be sufficient to recover the Leadbeater's Possum: that objective also needs harmonisation of existing and future planning and policy settings such that they collectively and coherently contribute appropriately to maximising the chances of long-term survival of Leadbeater's Possum in nature.*

Actions:

- Review and revise relevant current and future planning and policy settings to ensure the provide maximum chance of long term survival.

Conclusions: *This is a sensible proposal that needs to span the full range of forest management actions, including harvesting, fire management, biodiversity management and management of other natural values.*

Objective 2: A whole of landscape management regime is in place ensuring that all currently suitable and prospective habitat across the species' known range is maintained, enhanced and effectively managed to maximise its suitability for Leadbeater's Possum.

Rationale: *The key conservation concern for Leadbeater's Possum is ongoing decline in the extent, quality and connectivity of suitable habitat. This objective seeks to focus explicitly on the maintenance and management of habitat that is currently suitable, and habitat that will become suitable in the future. Where appropriate, retention of habitat should be through an increase in the dedicated reserve system to improve that system's adequacy, supported by complementary state forest informal reserves and values protected by prescriptions. A whole of landscape management planning approach is needed to identify, secure and effectively manage habitat as well as mitigating landscape and other threats, including capacity to respond to emergency events such as severe extensive fire.*

Actions:

- Enhance existing levels of protection for areas in which colonies are not known but may be present, by undertaking pre-harvest surveys in all coupes prior to proposed timber harvesting. If these surveys detect Leadbeater's Possum, the colonies must be protected from harvesting.

- Assess the feasibility, risks and cost-effectiveness of fire management options that seek to deliver long-term, strategic and landscape scale enhancement of the extent and quality of current and prospective suitable habitat. Develop and implement fire management that effectively secures and promotes long-term, strategic and effective protection of known colonies and suitable habitat.
- Enhance existing levels of protection for important habitat features by **protecting and buffering all live and dead hollow-bearing trees** [authors' emphasis] in montane ash forests within the distribution of Leadbeater's Possum.
- Review the conservation effectiveness of timber harvesting regulatory prescriptions and related guidelines relevant to the protection of known Leadbeater's Possum colonies and habitat, and refine these prescriptions and guidelines to provide more effective conservation outcomes.
- Refine and update occupancy and other relevant distributional and population viability modelling across the full range of the species (incorporating finer-scale mapping of key habitat attributes, such as large hollow-bearing trees and understorey density).
- Based on models developed in previous action, undertake landscape scale land-use planning that provides options for conservation of suitable habitat now and in the future to ensure an acceptably high likelihood of persistence (i.e. at least 99% over 100 year period) for Leadbeater's Possum.
- **Expand the dedicated reserve system** [authors' emphasis] to incorporate sufficient areas of current and prospective suitable habitat to ensure that it is adequate for the long-term conservation of Leadbeater's Possum.
- Assess the practicality and effectiveness of habitat augmentation including the provision of nest boxes, artificially excavated hollows, or manipulation of understorey. Where benefits can be obtained effectively, strategically implement these to enhance the current and projected extent of suitable habitat in the Central Highlands.

Conclusions: *This is a useful plan that recognises the importance of maintaining existing habitat through buffering HBTs and trying to create an expanded the reserve system. This is what LPAG was unable to consider due to its terms of reference. It is worth noting that Taylor et al 2017 and Todd et al 2016 [26,27] have already completed the action to update the population viability modelling across the full range of the species. Based on the modelling by Todd et al. 2016, which was underpinned by whole of landscape planning, it was concluded there is a need for a large ecological reserve covering all ash forests in the Central Highlands [26].*

Objective 3: Where there is net long-term benefit (i.e. likelihood of increase in overall population viability), translocate individuals or colonies *within* and adjacent to the known range.

Rationale: *The distribution of Leadbeater's Possum is fragmented, and probably increasingly so. Some small isolated subpopulations are likely to have especially low viability. There is probably little effective natural dispersal of individuals of this species over distances of more than 10 km. In addition, because of past events, some currently suitable habitat may now be unoccupied, or areas will become suitable in the near future (e.g. parts of the area burnt in the 2009 fires). Strategic translocations within the known range may decrease population fragmentation, and increase subpopulation viability and occupancy of suitable habitat. It is prudent to carefully trial such translocations early in the plan, given the likelihood of greater need for such actions in the future as the population size declines and becomes increasingly fragmented.*

Actions:

- Identify priority areas within and adjacent to the known range to which translocations may provide benefit to the possum's population viability. Assess the risks, potential impacts upon existing subpopulations, benefits, likelihood of success, and cost-effectiveness of translocation options. Develop appropriate protocols for use and implementation of translocation (most likely 'wild-to-wild' introductions).
- Assess the risks, benefits, practicality, cost-effectiveness and consequences of 'gene pool mixing' to increase the viability of the lowland sub-population.
- Where Actions 3.1 and 3.2 indicate likelihood of net benefit, undertake carefully monitored trial translocations, and – if successful – extend translocations to other priority areas.

Conclusions: *Additional research and surveys would be required to establish whether areas are unlikely to remain unpopulated. There are many issues with translocation (see LPAG discussion above) and it is a high risk strategy that has a large chance of failure.*

Objective 4: Seek to locate, or establish, additional populations outside the core range of the Central Highlands.

Rationale: *The conservation future of Leadbeater's Possum within its known range in the Central Highlands is precarious. Its overall conservation outlook is likely to be improved by seeking to spread extinction risks by establishing additional populations outside this known range, while the current population size may still allow for such translocation.*

Actions:

- Using recently developed survey approaches, survey potentially suitable areas (in Victoria) – including the areas predicted by habitat modelling to provide suitable habitat and/or where there are previous unverified records – outside the known range.
- If such surveys locate 'new' existing populations (beyond the Central Highlands), assess their status, population size, genetic affinities, habitat relationships, extent of suitable and prospective habitat and management requirements; and implement such management.
- If such surveys fail to locate existing populations, identify the most suitable candidate areas for translocation.
- Assess the welfare risks, likelihood of success, cost-effectiveness, and potential impacts upon existing populations of translocations to those areas outside the current range considered most practical and likely to result in the establishment of new viable subpopulations. If considered to have significant benefits, implement such translocations.

Conclusions: *The three main known habitats for Leadbeater's Possum – Swamp Gum, Montane Ash and Snow Gum – are currently very limited in extent. In the future, all are likely to be under significant stress and have further reductions in extent due to climate change, adding additional complexity to translocation efforts. As discussed above (LPAG, recommendation 11) translocation, especially to new areas, is highly problematic, often with unforeseen and sometimes perverse consequences. This is unlikely to be a successful long term strategy.*

Objective 5: Targeted research addresses key knowledge gaps such that management options are better informed and management actions more effective.

Rationale: *Notwithstanding several decades of intensive research, there remain some key knowledge gaps that constrain conservation management effectiveness. In some cases, where that research closely relates to other management objectives, the research actions are described within those objectives. Note that the actions described here should not be seen to limit research options. Other currently established or proposed research actions will also contribute to the objectives of this Plan.*

Actions:

- Establish an ongoing research forum to enhance existing collaboration among researchers, and between researchers, managers and other interested parties, to make the most effective use of research actions and to identify and address any further key knowledge gaps.
- Undertake research that provides more robust knowledge of key demographic and other ecological characteristics relevant to conservation management, specifically including dispersal characteristics and population size.
- Investigate key aspects of the post-fire ecology of Leadbeater's Possum. This research should include at least: (i) assessing current hollow availability and the importance of large dead and any live hollow-bearing trees in the burnt landscape; (ii) investigating hollow development within trees that were 1939 regrowth before being burnt to determine their potential to provide nesting sites into the future; and (iii) investigate persistence of colonies within fire refuges surrounded by burnt areas, to determine if they will be effective sources for natural recolonisation or if translocations will be required to accelerate recolonisation of the regenerated burnt areas.
- Design and implement experimental trials that rigorously assess the relative benefits of prescriptions, actions and other management options, in a manner that allows results to inform ongoing refinement of those prescriptions and actions and the Plan itself.

Conclusions: *Additional research on dispersal characteristics, post-fire ecology, hollow development and population size is welcome and several of the questions above are already being investigated by ANU and others. For adaptive management to be achieved (Objective 8, below), the integration of research findings (past and future) must be achieved. However, research that feeds into decision making and policy setting should be publicly scrutinised and critically peer-assessed before being accepted or published. As discussed in Chapter 7, there have been many reports published that either make recovery of the species more difficult, or at best, add confusion or distractions in a complex area of management.*

Objective 6: An integrated monitoring program is effectively implemented (and maintained) that publicly reports in a timely manner on possum status, existing and prospective habitat extent, quality and connectivity, and effectiveness of management actions.

Actions:

- Collate existing monitoring data and programs (for population trajectories, extent and suitability of habitat, and management effectiveness). Maintain, enhance or develop new monitoring programs to ensure an integrated monitoring and survey program across all tenures and management zones and develop an effective public reporting of monitoring results.
- Identify key trigger points or thresholds in monitoring results that would catalyse priority emergency response (and identify such emergency response options).
- Where translocations are proposed, design translocation trials in a manner that allows for reporting on success or failure, and those factors that contribute to this fate. Monitor those trials, and use results to refine the efficacy of translocation protocols, or to assess critically whether they are of net benefit.
- Monitor the extent of success (including cost-effectiveness and collateral benefits) of management actions individually and collectively, and use such information as appropriate to refine actions.

Conclusions: *Monitoring is critical and is the only way to be able to critically appraise the effectiveness of management actions (Objective 8). Underlying any monitoring must be robust statistical work using appropriate models with limitations of underlying assumptions recognised and promoted. Appropriate reporting of data is required (e.g. actual nest box occupancy by colonies) rather than data that may give misleading representation (e.g. 'signs of occupancy' in nest boxes). Unless consistent methodology is used and reported, comparing the results from sequential reports will be unreliable and unable to underpin accurate analysis of change.*

Objective 7: All stakeholders support and where relevant are involved in the implementation of the Plan.

Actions:

- Establish (or build from existing mechanisms) and maintain an effective recovery team or similar governance model to oversee implementation of the Recovery Plan, and ensure effective and timely operation of such a team.
- Involve the community in Leadbeater's Possum recovery.
- Provide enhanced opportunities for the participation of Indigenous groups in research, monitoring, management and other components of this Plan.
- Promote and publicise the Recovery Plan and recovery effort.

Conclusions: *This objective recommends returning to what was in existence prior to the formation of LPAG. If the Recovery Team is to be re-established, there should be recognition that decision making around threatened species must follow three distinct steps; experts describe what actions are required for species recovery; affected stakeholders then describe the impacts the different actions would have on them; finally government makes an informed decision balancing the actions against their impacts on stakeholders. Decisions must comply with statutory obligations under State, Commonwealth and international laws and regulations.*

Objective 8: Ensure effective and adaptive implementation and management oversight of the Plan including adequate resourcing.

Actions:

- All partners in the Plan coordinate and adequately resource implementation to achieve objectives through adaptive management and cost-effective delivery.
- Establish appropriate governance and protocols to be able to respond to emergency events.
- Monitor the extent of implementation of management actions.
- Report regularly on performance effectiveness of this Recovery Plan, including a formal review at 5 years, and adapt as required.

Conclusions: *Adequate resourcing for all stages from implementation to monitoring and review is imperative if the full process of gaining knowledge from implemented actions is to be achieved.*

Leadbeater's Possum (Photo: S. Kuiter)

Chapter 4: Leadbeater's Possum population statistics

Key points

- Population trend is more important than overall population size.
- Population trend has been declining since the 1980s and continues to trend downward due to declining habitat quality and loss of hollow-bearing trees.
- Overall population is very difficult to measure due to the cryptic nature of the possum.
- Estimates of overall population range from 1,500 - 10,000 individuals.
- The increase in sightings in the last 3 years is very likely to be due to the increased survey effort, not significant increases in population [2].
- Increases in new sightings do not change population trend estimates but help improve overall population estimates, if data are interpreted correctly.
- Overall population modelling remains poor due to a lack of habitat (old tree) mapping.
- Leadbeater's Possum was uplisted by the Threatened Species Scientific Committee from Endangered to Critically Endangered in 2015 due to ongoing decline in habitat. The reasons for uplisting have not changed and the situation has not improved.
- Using sightings to infer minimum population through simplistic calculations is flawed and ignores many important underlying assumptions.
- Population estimates rely heavily on movement data, which unfortunately for Leadbeater's Possum is very limited, but studies using radio tracking recorded movements up to 600m between dens and average inter-den movements of 135m [43].
- Recent surveys that have led to an increase in the number of sightings were completed in areas where LBPs were expected or known to occur.
- Modelling for LBP population estimates makes an invalid assumption that all of the forest estate is as densely 'stocked' with possums as areas surveyed.
- Many current colonies will not continue to persist in 10+ years due to habitat deterioration.
- While THEZ buffers around sightings is likely to help slow population decline, recovery of Leadbeater's Possum is unlikely to occur without increases in the number of hollow-bearing trees.

Population size and population trend

In population ecology, there are two main measures of importance – overall (or breeding female) population size and the population trend. Of the two, population trend is the more important but can be the more difficult to estimate as it requires monitoring over long periods of time. ANU has excellent population trend data for Leadbeater's Possum because it has conducted research over 34 years using a consistent survey methodology (stagwatching) that generates time series data, and is capable of being subject to rigorous statistical analysis. These data allow us to model how the population has changed over time and how it is likely to fare in future [18,33,62].

Survey method and data interpretation

The survey methodology used by ANU for possums and gliders has been specifically designed to detect population trends over time. Recent surveys conducted by ARI or WOTCH do not have the ability to do this. They have been conducted with the specific purpose of finding new colonies and

do so by surveying a different location each time with variable area covered by each survey and minimal descriptions of environmental variables linked to the observations. In contrast, ANU has repeatedly surveyed the same sites, year after year. We have 180 long term monitoring sites that have been carefully selected to encompass a wide range of forest ages and conditions. On these sites we have described a wide range of habitat conditions, including presence and form of hollow-bearing trees. We have also documented how these variables have changed over time. Possums and gliders are surveyed in a consistent way each year on a rotating subset of the sites. The method we use (stagwatching) is non-invasive and observes the animals' natural behaviour. The survey method is repeatable, with results of each survey not influenced by any previous surveys. With repeated observations through time and linking animal presence to environmental variables as well as change in these variables, we are able to achieve a statistically robust interpretation that is not able to be achieved through other methods. It is from these data that we are able to confidently show the population of Leadbeater's Possum is declining (see Figure 4.1). Although many of our sites do not have Leadbeater's Possum, and have not had them during the prolonged period of study, knowing what forest conditions do not support the species can be just as important as finding areas where there are Possums.

Population trend

The Leadbeater's Possum population has been declining since the 1980s and continues to do so due to deterioration of its habitat. All credible current scientists who study Leadbeater's Possum agree with this assessment, including those from Zoos Victoria, experts within DELWP and independent universities such as The Australian National University. The recent rapid increase in observations does not change this (see "600+ sightings – what does this mean?" below).

From our long term data, we are able to plot change in Leadbeater's Possum population. Figure 4.1 shows the proportion of ANU sites surveyed that had Leadbeater's Possum present. The overall trend shows a highly significant decline in population over the last decade. Importantly, Figure 4.1 shows results from only those ANU sites that still support hollow-bearing trees. When initially established, all ANU sites had hollow-bearing trees. Unfortunately, like so much of the forest estate, that is no longer the case. The rates of HBT collapse were discussed in Chapter 2; currently 16% of ANU sites now support zero HBTs. We do not continue to stagwatch sites with no HBTs as we have found these sites do not have Leadbeater's Possum. The more accurate trend for Figure 4.1 if we had included sites without HBTs would be a greater level of decline. Our data supports the modelled trends done by ARI (Figures 4.2 and 4.3).

Population trend was modelled by ARI using the available data in 2013. The modelling (see Figures 4.2 and 4.3) shows recovery of the species after the widespread fires of 1939 when the species was thought to be extinct (the population in the Central Highlands region prior to this was unknown) and then recovery peaked about 20 years ago and began to decline as habitat deteriorates. The recovery after 1939 was due to widespread availability of standing large old dead trees that resulted from old growth trees killed by the 1939 fires that were not salvage logged. As these dead trees continued to collapse due to natural decay processes, the population began to decline. The species was well into this decline when the 2009 fires burnt through 34% of the Central Highlands ash and Snow Gum forests [23] and 45% of the Leadbeater's Possum reserve [23]. Leadbeater's Possums were likely to be killed in all areas that were burned at low and high severity in 2009, leading to the modelled reduction in Figure 4.2. Note, this model assumes there will be no logging and no fire for the 200 year period modelled.

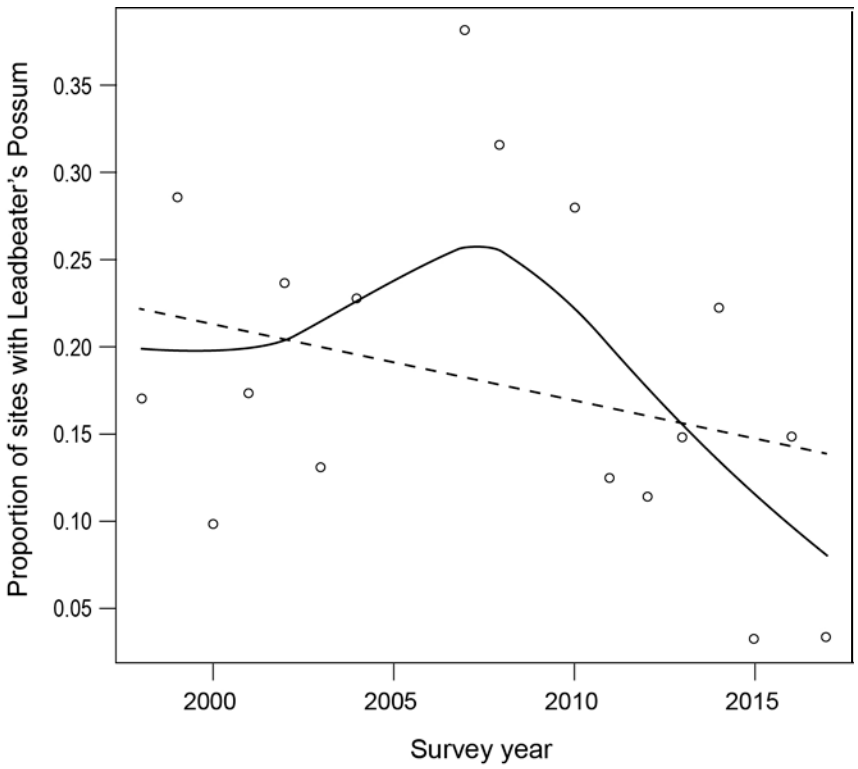


Figure 4.1: Proportion of surveyed ANU monitoring sites with Leadbeater's Possum between 2008 and 2017 (dashed line is logistic regression, solid line is Generalised Additive Model). Note that the 16% of sites which no longer support hollow-bearing trees were excluded from the analysis.

Unlike the fires of 1939, the 2009 fires primarily burnt young forest, trees that had been growing for 70 years or less. These trees are generally not large enough, or old enough to have the internal cavity development of older trees (150+ years old) [21]. Therefore, following the 2009 fires, instead of a pulse of new habitat available to the possum (as occurred in 1939), many of the few remaining old dead trees generated by the 1939 fires were lost and the 70 year old live forest was returned to very young forest again (see Figure 4.4, barrier to recruitment). Some areas of old forest burned (mainly in O'Shannassy water catchment), and they will be critically important habitat over the coming decades, but it is geographically very constrained, and susceptible to future disturbances [21].

The slow recovery in the population trend curve around 2089 is due to the 1939 cohort of trees becoming old growth (150+) and beginning to develop hollows. Occupancy and use of HBTs actually continues increasing until the trees are 190 years old [21]. However to reach these ages, this assumes these stands will not be logged or burnt over the next 70–110 years.

Figure 4.3 is a more realistic scenario than Figure 4.2, with one additional large fire (in 2020 in the modelling), which further depresses the population trend line towards extinction. With climate change and a landscape now comprising primarily young forest that is highly susceptible to intense wildfire [48], the even more likely scenario was not modelled, that is of multiple large fires in the Central Highlands over the coming 70 years, with each fire further depressing the population trend closer to extinction. (There were more than 5 major fires in the Central Highlands over the last 100 years).

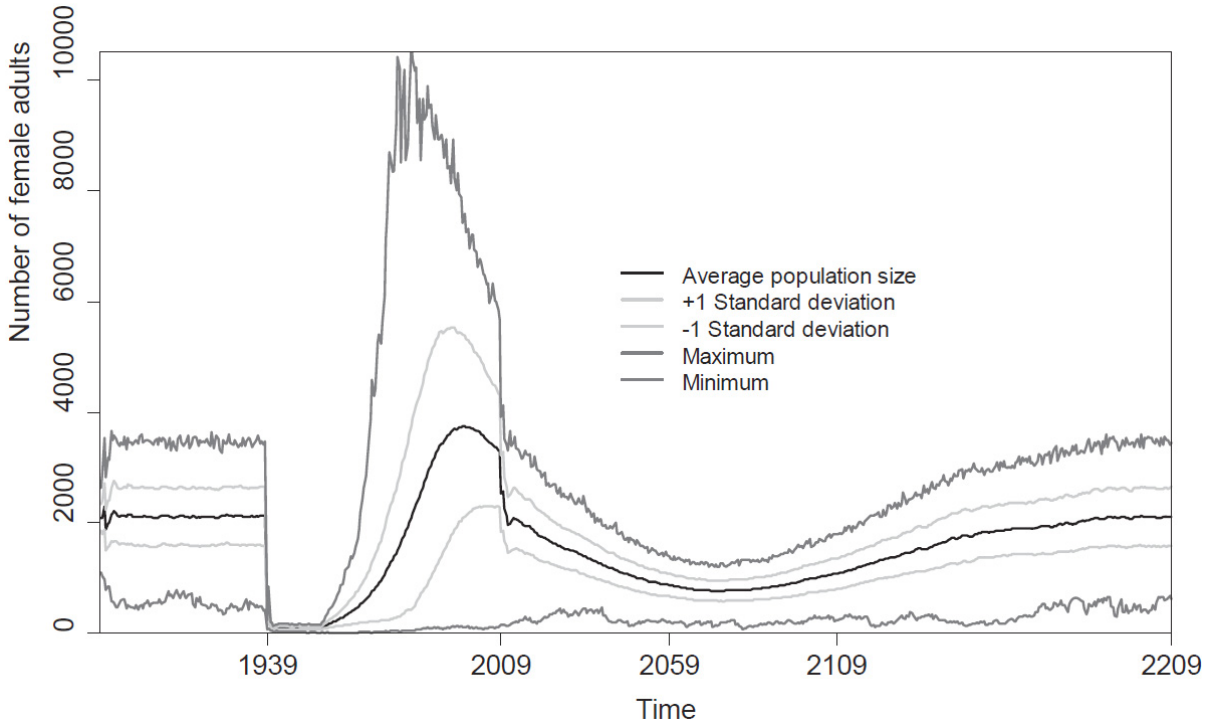


Figure 4.2: Leadbeater's Possum population trend modelling the best case scenario with no fire, no logging and no increased habitat deterioration for the next 200 years (Source: [18,26])

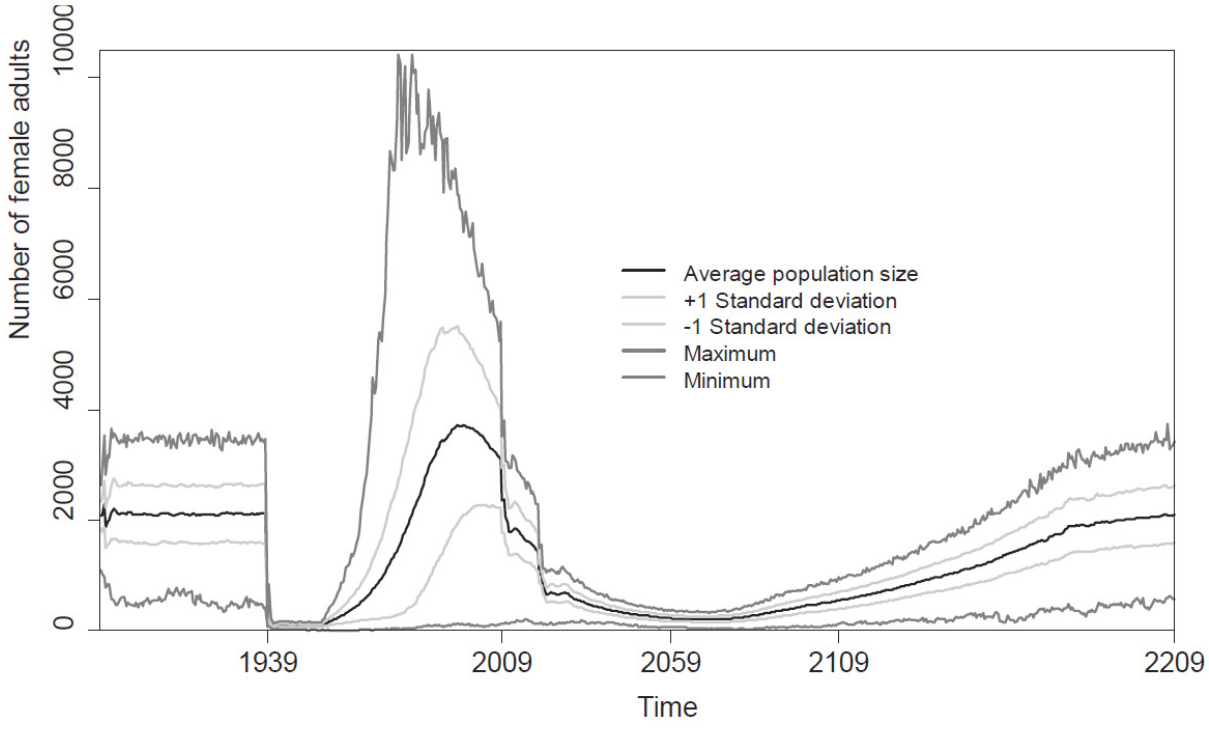


Figure 4.3: Leadbeater's Possum population trend with one additional fire burning half of reserve in 2020 (Source: [18,26])

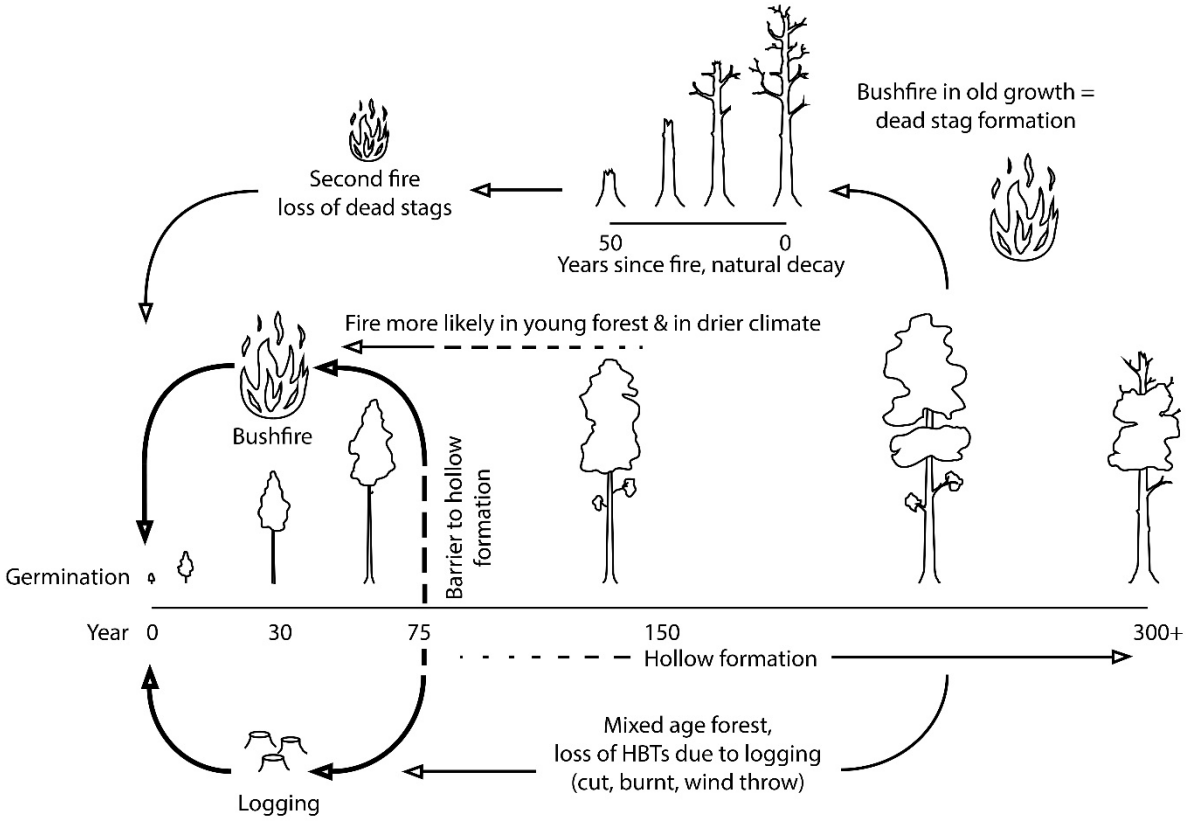


Figure 4.4: Barrier to recruitment of hollow-bearing trees. Diagram shows logging and fire in forests less than 120 years old prevents hollow development. Old trees that burn are good habitat until a second fire when they are usually lost. (Source: [33])

Overall population size

Accurately estimating the overall population size of a nocturnal cryptic species like Leadbeater's Possum is very difficult. Unless an overall population is very small, such as the Yellingbo population of 38 animals or zoo population of 13 individuals, populations are usually estimated using the integration of field data and modelling (see Table 4.1 for a range of estimates).

Due to detailed studies of Leadbeater's Possum over decades, we know that the key habitat determinant for this species is large old trees. Unfortunately, a GIS layer showing large old trees has not been created. As a result, modelling, such as ARI's occupancy model [18] and VEAC's Fibre and Wood Supply report [45], have modelled likelihood of occurrence on far less closely correlated variables such as 'topographic wetness index' and forest age. These predict where Leadbeater's Possum will exist far less accurately than the presence of hollow-bearing trees. As a result, predictions resulting from such modelling will have wide margins of error due to the poor correlations of the underlying assumptions in the model. See discussion of these in Chapter 7 below.

There have been many attempts to estimate the overall population of Leadbeater's Possum. The 2016 report by the Leadbeater's Possum Management Team listed population estimates by various experts. These are shown in Table 4.1.

Table 4.1: Draft National Recovery Plan Table 3, Leadbeater's Possum population estimates [55]

Source	Estimated total population	Notes
Estimates prior to 2009 fires		
Smith et al. 1985 [63]	7500±2300	Does not include Snow Gum or lowland woodland populations
Lindenmayer & Possingham 1996 [64]	4000	As above
Menkhorst & Lumsden 2008 [65]	2200	Includes estimate of 200 at Yellingbo
Estimates post 2009 fires		
Woinarski et al. 2014 [66]	1100*	* Mature individuals only, includes all wild populations
Leadbeater's Possum Advisory Group 2014 [23,25]	3945–10960	Includes Snow Gum populations
Lindenmayer advice to Threatened Species Scientific Committee, 2015	3125	Mountain Ash forests only
Current Yellingbo population	38[#]	[#] Estimate not part of the Draft National Recovery Plan, but given to David Blair (author) by Dan Harley, pers comm, 8/2017

600+ sightings – what does this mean?

Since 2014, there has been a dramatic increase in the number of confirmed sightings of Leadbeater's Possum. VicForests is running a 'counter' on the home page of its website (650 at the time of writing this report; August 2017) and there is increasing commentary from media, politicians and industry that this indicates the possum is recovering. It is even being used as part of the reasoning behind a submission to downlist the species to Endangered (see below). **The increase in sightings is entirely confounded with a substantially increased survey effort in that time, and is not indicative of a population recovery or population health** [2].

In implementing LPAG recommendations, in April 2014, there was a fundamental change in policy regarding the protection of Leadbeater's Possum under the Code of Practices. Prior to 2014, Leadbeater's Possums were protected through protecting prime habitat. LPAG recommendation 1 [25] introduced Timber Harvesting Exclusion Zones (THEZ) to verified records of Leadbeater's Possum sightings. Following this, considerable effort was invested in surveying for animals by both ARI and the community. The result has been a dramatic increase in confirmed sightings.

The sightings do not indicate an increase in population as they have generally occurred where LBPs are expected to be, but in areas that simply had not been surveyed previously.

Can we predict population size using recent sightings (and should we try)?

The recent sightings will help improve our estimates of overall population size as there are more data, however, these data points need careful interpretation.

VicForests, on its website, is using sightings to predict a minimum population, simply multiplying the number of sightings (650) by three to reach a minimum population figure (1950). There are a number of problems with this.

The figure of 650 sightings that are recorded in the Victorian Biodiversity Atlas (VBA) includes numerous historic sightings dating back to 1998. Since 1998, the habitat in many areas that once supported Leadbeater's Possum has deteriorated with hollow-bearing trees collapsing. Thus, many of these sites are no longer suitable and possums are no longer there. **In another 10 years, many of the locations currently supporting Leadbeater's Possum will also be unsuitable** as hollow trees continue to collapse [22]. Striving to find **an accurate overall population figure** in 2017 **is interesting,** but it is knowing **how the population is changing over time** that is critical for the conservation of the species.

There is an assumption that each 'sighting' is a separate colony. This is most unlikely to be the case, as many sightings are clustered close together. How far LBP travel each night is a key knowledge gap, but radio-tracking conducted in the early 1990s found average movements of 135m between den trees, with movements over 200m not uncommon and records of movement up to 600m [43,67]. The area where radio tracking was completed was high-quality habitat with numerous hollow-bearing trees. In areas of young regrowth forest characterized by far fewer and more widely spaced hollow-bearing trees, the LBP may need to range even further. Sightings also may be of dispersing young or single males that have been recorded moving 1400m in the habitat constrained area of Yellingbo [68].

Several of the sightings were recorded using call playback via a megaphone. It is unknown how far this method draws in animals. Given the limited buffer size, it is quite possible the den trees are outside the THEZ logging exclusion buffer. Other surveys using active searching or camera traps are more likely to capture the animals within their usual home range.

Population size can be estimated by sampling a range of sites and extrapolating the findings over broader areas that have not been surveyed. However, this requires knowing the area that has been sampled, and if sampling is not well designed, biases can make the results unreliable. Any modelling using the current sightings must account for the bias that surveys have been conducted in areas most likely to have Leadbeater's Possum. Therefore, simplistic estimates based on calculations assuming all forest will be uniformly 'stocked' with possums is likely to be highly misleading.

How underlying assumptions in modelling affect estimates of Leadbeater's Possum population size

Different approaches exist for modelling the population size of a species, and there is always a margin of error around the result. Recent population size estimates for Leadbeater's Possum, as modelled for LPAG [25], were extrapolated from 29 field sightings at 180 field sites surveyed only once. An underlying assumption was that the sampling area (the distance Leadbeater's Possum could be called in with a megaphone over an hour of surveying) was a radius of 150-250 metres.

The estimate of population size was provided as a range from 3,945 to 10,960. This population estimate has been used widely since then, especially the upper range of the estimate by the forest industry.

We do not know if the assumptions of the 'detection radius' used for these estimates are correct. There is currently no information to support this assumption, nor of variability in this important parameter among different forest types. For instance, if the sample area radius was 350m or even 450m, as shown in Table 4.2, this underlying assumption of the model substantially alters the population estimate. Based on our current understanding of the biology of the species, little confidence can be placed in the estimates of total population size as extracted from the call playback surveys.

Table 4.2 Variability of population estimates with effective survey area

Effective survey area			
Radius (m)	**Area (ha)**	**No. of colonies**	**No. of individuals**
100	3.1	9,907	24,766
150	**7.1**	**4,384**	**10,960**
200	**12.6**	**2,466**	**6,165**
250	**19.6**	**1,578**	**3,945**
300	28.3	1,094	2,734
350	38.5	804	2,009
400	50.3	615	1,538
450	63.6	486	1,215
500	78.6	394	984

Other assumptions – about colony size, the use of environmental descriptors and assuming the areas surveyed were representative of the broader landscape – can all significantly alter population estimates. Just as it is unlikely the population is as low as 1500 animals, it is also unlikely it is as high as 10,000. For this reason, the Leadbeater's Possum Management Team considered these estimates to contain a very high level of uncertainty [55].

It is possible that previous population estimates underestimated overall population, as Population Viability Analysis done for the species was lacking detailed habitat descriptions. However, overall population has not been the focus of ecologists working on the species as it is not particularly helpful to have more accurate figures. We could spend a lot of time and effort trying to achieve more accurate population estimates, but ultimately not learn anything helpful to save the species. There are many famous examples of species rapidly going extinct from high populations where lessons have been learnt that understanding and paying attention to population trends is of utmost importance [69]. The best known is the Passenger Pigeon which went from being the most populous bird in North America in 1870 with flocks containing hundreds of millions of birds, to being hunted to extinction a few decades later. Although this was a century ago and our understanding of ecology has improved, our ability to impact rapidly on the environment is also far greater than a century ago. Australia has also undergone similarly rapid losses in populations including those of the Brush-tailed Rock-wallaby and the Koala.

Uplisting vs downlisting, Critically Endangered (CR) or Endangered (EN)?

Leadbeater's Possum was uplisted to Critically Endangered following recommendations by the Threatened Species Scientific Committee (TSSC) in 2015. The Conservation Advice [12] to the Minister outlined the **major threats to the species coming from habitat loss and deterioration**. The drivers of habitat deterioration are primarily fire and logging (with additional causes at Yellingbo).

The listing of Leadbeater's Possum is done in accordance with strict guidelines set out by the IUCN. On advice from scientific experts and based on published peer reviewed work, the listing of LBP as Critically Endangered was based on Criterion A2(c) and A3(c) which related to **population decline and reductions in habitat quality**. Both habitat and population have declined due to fire, logging and continued loss of hollow-bearing trees. The species also has **the most restricted range of any Australian mammal** [12] making it susceptible to large disturbance events like fire.

The assessment period was three generations of possums, or 18 years and with fire occurring on average every 10 years over the last century [18,70] and fire frequency expected to increase in future [71], additional fire was predicted in the assessment period and built into population trend models. Taking this into account, within the 18 year period the **overall population was estimated to decline by 80%**.

Following the increased sightings in the last 3 years due to greatly increased survey effort, forest industry groups have lodged formal nominations for the species listing be downlisted to Endangered based on 'new knowledge'. Their contention is that with recent sightings, the population is greater than previously estimated, and surveys have shown the possum to be using regrowth forest and nest boxes. That representatives of the timber industry (with no ecological qualifications) feel qualified to comment on a species they do not study is interesting, but their claims are poor. We have known for 30 years that Leadbeater's Possum uses young regrowth forest, provided large old trees are present. Nest boxes have mixed success (as discussed in Chapter 3, LPAG recommendation 9), but have also been studied in detail [50,72]. Nest boxes and artificial hollows are not considered economically feasible to establish at the spatial and temporal scales (e.g. the next 100 years) that would be required for the long-term persistence of the species [18]. Leadbeater's Possum has been found in forest burnt in 2009 over the last couple of years, but only in very specific locations where large old trees have persisted (usually as the remains of large live trees that were killed in the fire). Total population is discussed above in the light of recent surveys. However adjustments of total population estimates do not change the population trend as it was assessed by the TSSC. There has not been any peer reviewed science published from the recent surveys that could feed into such a decision making process.

How big is the home range of Leadbeater's Possum?

For a species as well studied as Leadbeater's Possum, **knowledge of home range size in the montane ash forests is limited**. The estimates of home range originated from a trap-recapture study in 1988 [67] with additional work done in 1996 [43]. These studies analysed **daytime use of den trees**, and attempted to find movement data at night. However, the night radio-tracking work was short lived as the researchers found themselves flushing animals beyond where they would naturally have foraged, compromising the understanding of habitat use, social behaviour and foraging range. The day time radio tracking study of den use found **Leadbeater's Possum uses between 1 and 7 den trees, with trees usually more than 50m apart, averaging 135m apart, and up to 600m apart [43]**. Much of the habitat Leadbeater's Possum is found in now has deteriorated significantly compared to the habitat at the time these early studies were conducted. It is likely that with far fewer hollow-bearing trees per hectare now, Leadbeater's Possums are expanding their home ranges to be able to access a similar number of HBTs [73].

In separate studies at **Yellingbo Nature Conservation Reserve**, Dr Dan Harley observed movement distances of around 165m between den trees. He also found **long distance dispersal movements** at Yellingbo, with females ranging 125-1080 m and males 105-1460 m (Figure 4.5) [68]. These distances demonstrate that **dispersing young need connected habitat extending well beyond the current 200m THEZ buffers**. Dr Harley's work showed that adjacent colonies are vital stepping stones for dispersal across habitats, including for females. Yellingbo is generally more geographically constrained than most areas of the Central Highlands forest habitats, and this should be considered when interpreting these results.

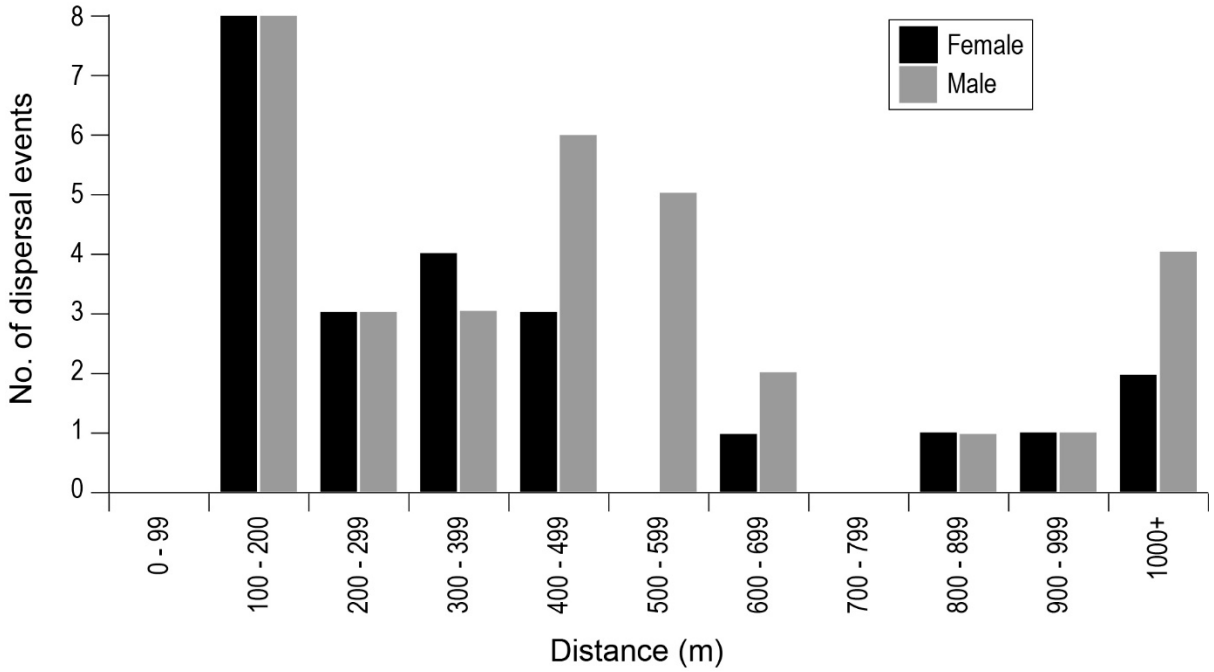


Figure 4.5: Dispersal distances of female and male Leadbeater's Possum at Yellingbo Nature Conservation Reserve. (Source: [68])

Foraging range is more difficult to determine, but is likely to vary with available food resources and habitat connectivity. Field observations from stagwatching indicates Leadbeater's Possum usually does not remain near its den tree, with movements over 100m being common. A current study is using GPS technology to provide data on how animals move around their habitat, particularly their foraging range and should greatly assist in closing this knowledge gap.

It is not known if the Timber Harvesting Exclusion Zone (THEZ) buffers are adequate in size to allow Leadbeater's Possum to persist [2], but it appears unlikely they are large enough for dispersing young. Given it could be 10+ years before surrounding logged and regenerated habitat is suitable for dispersal of young, this would mean 2+ generations would need to survive within the retained patch and it could be assumed no offspring from those colonies would survive. This is inadequate protection for a Critically Endangered species.

Several studies indicate the current THEZ buffers are too small, particularly given buffers are based on sightings, and therefore may be centred on the edge of a home range. The post-fire refugia studies show minimum areas for persistence immediately post-fire are 10-12 ha (Chapter 7) [18,28]. Radio tracking studies show animal movements between den trees can exceed 200 m [43] (the radius of the buffer) and, as explained above, the buffers are far too small for the dispersal of young, which can be over a kilometre (in the limited habitat area of Yellingbo)[68]. Leadbeater's Possum rarely go to ground (ARCUE, unpublished data) so isolating patches within a coupe area is likely to have fragmenting effects. Furthermore, Leadbeater's Possum is known to be affected by the 'halo effect' of disturbance [40], which may add to the explanation of why a 12 ha buffer is insufficient for an animal with the majority of its den trees on average within 3 hectares (although 'home range' is likely to be much larger than this).

Population estimates are influenced by home range size. Currently it is assumed each sighting (and THEZ buffer) is a separate colony. It is possible that each buffer covers multiple colonies, but it is more likely, based on the few radio tracking studies completed to date, that individuals foraging widely within a single home range have been sighted in multiple locations and therefore triggered

the establishment of multiple buffers. Unless we know, on average, how many colonies each buffer supports – whether that is a single colony per buffer, more than one colony per buffer or multiple buffers per colony – then overall population estimates using buffer numbers could be quite inaccurate.

Logging coupes in Victorian Central Highlands (Photo: D. Blair)

Chapter 5: Forests and forestry in the Central Highlands of Victoria

Key points

- The ash forest estate is now dominated by very young forest which means a declining supply of sawlogs, reduced water yields, limited old growth and increased fire proneness.
- If LPAG old growth targets are to be met, logging of 1939 age forest must cease immediately.
- The buffers aimed at protected colonies of LBP colonies affect relatively little forest (<5,000 ha) compared to areas predicted to be affected by fire (17,400 ha in next 20 years) and climate change (70,000 ha by 2080).
- The timber industry in the Central Highlands of Victoria is claimed to be a sawlog-driven industry. However, given reductions in sawlog yield, but not in pulpwood, the volumes of pulp from the Central Highlands until 2030 will be far in excess of what would be the expected levels of by-product or waste from a sawlog driven industry.
- Widespread thinning to provide pulp to meet demands under the Australian Paper contract will have significant negative effects on the forest environment.

Good forest management requires interpretation of a wide range of data. Published figures from the Central Highlands region relating to forest cover, age classes, areas in reserves and other kinds of land tenure are often difficult to interpret as it is often not clear what they relate to, or the information presented is too general, encompassing many forest types or reporting on broad areas rather than giving detail (see Table 5.1). For example, forest types are now described as 'ash', 'durable' or 'mixed species' where previously these were split into many more groups. Similarly, data are often given for 'Eastern Victoria' which makes interpretation for any FMA or RFA area difficult. Additionally, there can be different definitions of particular areas and regions. For example, the 'Central Highlands' region may refer to the Central Highlands RFA area, a combination or parts of the three FMAs (Central, Dandenong, Central Gippsland) covered by the RFA area (see Figure 5.1), or it may refer to an area defined in another way, such as the range of Leadbeater's Possum.

In Tables 5.1 and 5.2, we have attempted to draw together basic figures relating primarily to the montane ash forests of the 'Central Highlands'. Generally this relates to the ash forests on crown land within the RFA boundary. We have obtained these figures from a range of sources, as much as possible from government reports, although within these, figures are often conflicting or poorly defined.

The age vs area graph from the VEAC report (shown here as Figure 5.2) is one example of confusing data. The graph heading in the report does not specifically state what forest area it refers to, the paragraph preceding the graph indicates it relates to the Central Highlands, but upon seeking clarification, we were told it actually shows 'available' and 'suitable' ash forest for the whole of Eastern Victoria.

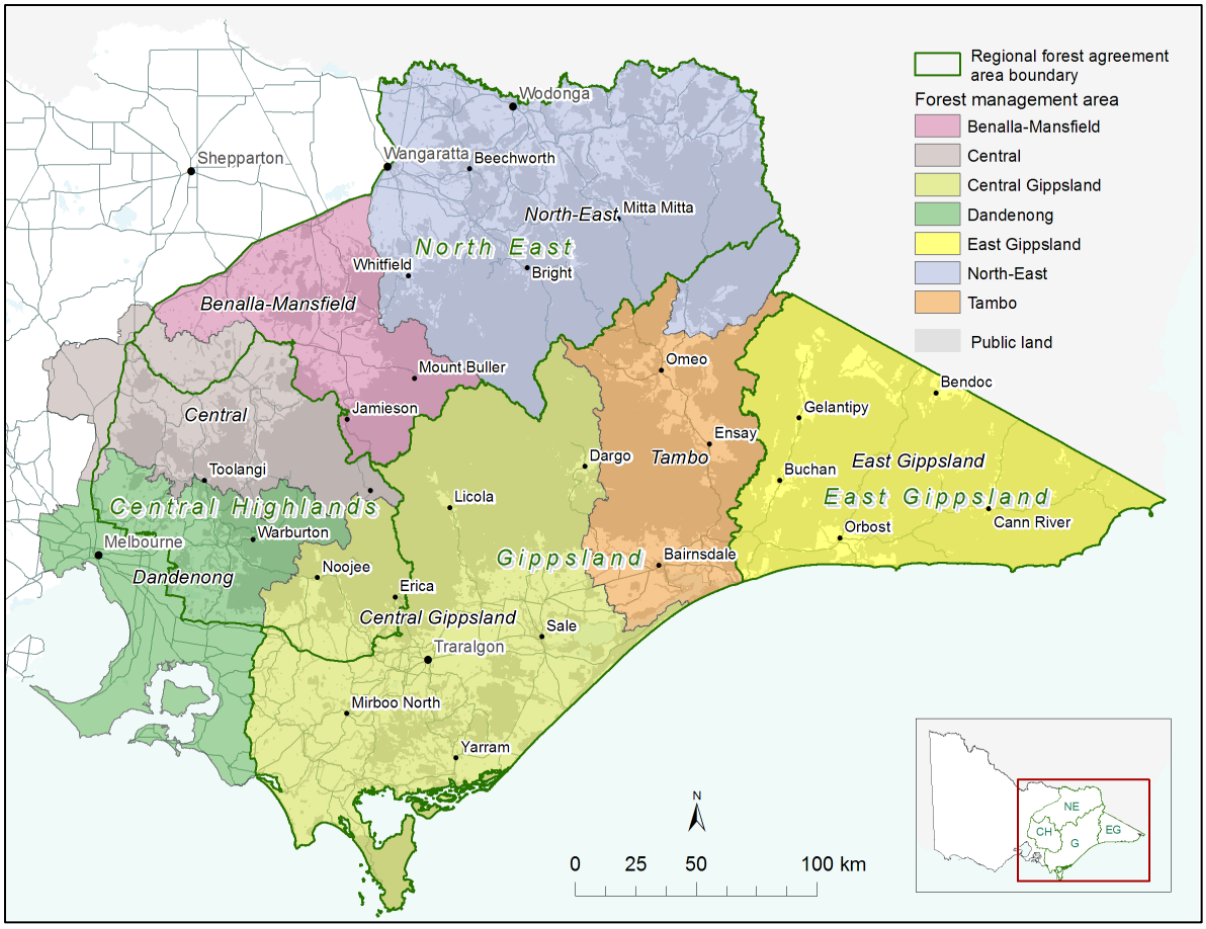


Figure 5.1: Map of Forest Management Areas and Regional Forest Agreement areas in Eastern Victoria (Source: [45])

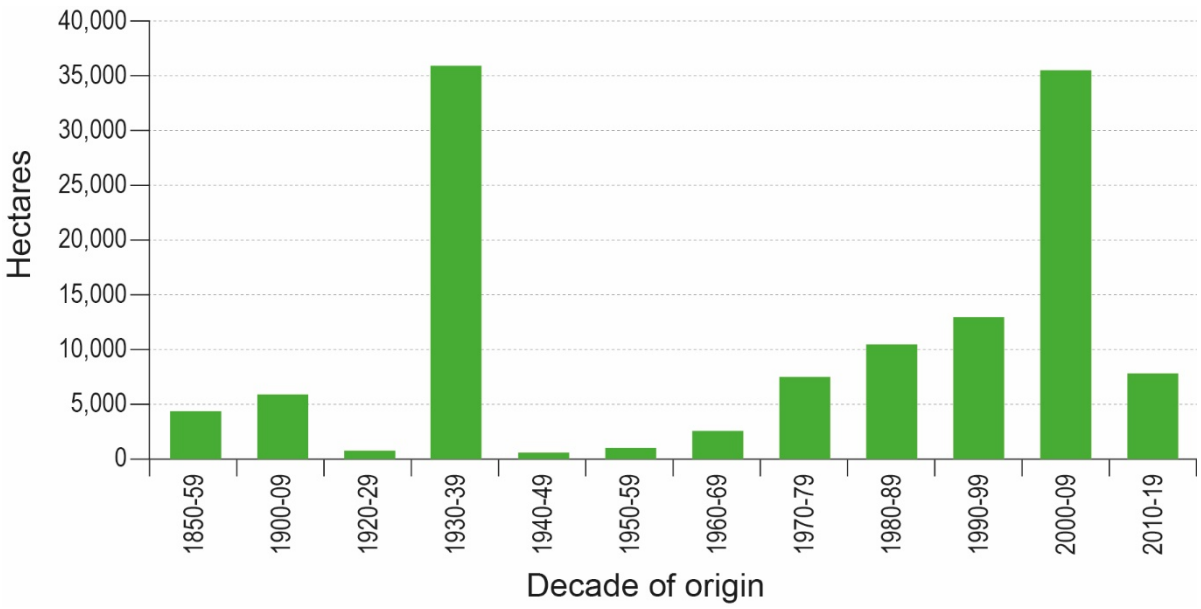


Figure 5.2: Age vs area graph for 'available' and 'suitable' ash forest in the State forests of Eastern Victoria. (Source: [45] with clarification provided by VEAC, pers comm)

Table 5.1: Native forest areas

Description	Forest type	Area (ha)	Notes	Source
Victoria	All native forest	7,900,000	Public (crown) land	[74]
State forest, Victoria	All native forest	3,138,000	Includes SPZs and reserves	[75]
	Ash	285,000		[75]
	Mixed species	2,731,000		[75]
Eastern Victoria State Forest 'available forest'	All	1,842,877	RFA areas NE, E Gipps, Gipps, Central Highlands	[59]
Central FMA 'available'	Ash	37,000	1,000 ha 'not suitable'	[75]
Central Gippsland FMA 'available'	Ash	44,000	6,000 ha 'not suitable'	[75]
Dandenong FMA 'available'	Ash	14,000	1,000 ha 'not suitable'	[75]
Total 'available' and 'suitable' in 3x FMAs of Central Highlands	Ash	87,000	Central, Central Gipps, Dandenong FMAs, 'suitable' and 'potentially suitable'	
State Forest SPZ, E. Vic	All	625,325		[45]
Central Highlands State forest and NP	Ash	165,000-240,000	Depending how "Central Highlands" area and "ash forest" defined	[25,44]
Central Highlands [1]	Alpine Ash	34,487	Conservation areas	[14]
		29,961	Timber production areas	
	Mountain Ash	66,143	Conservation areas	
		70,081	Timber production areas	
'Available' and 'suitable' ash forest in Eastern Victoria	Ash, all ages	126,000	Calculated from age v area graph, Figure 5.2	[59]
	Ash, 1920 or older	12,000	From age v area graph	[59]
	Ash, 1939	36,000	From age v area graph	[59]
	Ash, 1940-1969	4,000	From age v area graph	[59]
	Ash, 1970-1999	27,000	From age v area graph	[59]
	Ash, 2000 or younger	44,000	From age v area graph	[59]
Burnt in 2009	All forest/all land types	400,000 [2]	All land tenures "in and near the CH"	[59,76]
	Ash + Snow Gum	68,000	34% of Central Highlands	[25]
	Ash	80,000 [3]	All land tenures	[59]
Burnt in 1939	All forest	133,200	85% of Central Highlands	[44]
Estimate, suitable ash forest in CH FMAs likely to burn within 20yrs	Ash	17,400 [4]	From modelling by Baker et al, using FMA area [4]	[60]

Estimate, suitable ash forest in CH FMAs unable to persist naturally under climate modelling	Ash	69,600 [(4)]	From modelling by Baker et al, 3°C climate change by 2080, using FMA area [(4)]	[60]
VEAC estimate, ash forest 'lost' due to LBP buffers	Ash	4,921	Modelling by Baker et al, based on 518 sightings	[60]
Potential LBP habitat	Ash + Snow Gum	200,000		
Ash in LBP range projected to be harvested		63,000	31% of potential habitat	[25]
Potential LBP habitat burnt in 2009	Ash + Snow Gum	69,200	34% of potential habitat	[25]
LBP habitat in reserves	Ash + Snow Gum	69,200	34% of potential habitat	[25]
2008 LBP reserve	Ash	30,500	127 patches each >50 ha, most in NP	[45]
2008 LBP reserve that was reserve or SPZ prior to 2008	Ash	26,000		[45]
State Forest put into the 2008 LBP reserve that was not already protected	Ash	2,500	Became SPZ in 2008	[45]
LBP reserve burnt in 2009	Ash	14,000	45% of LBP reserve	[25]
Old growth, pre-1700, CH	Ash	55,000-190,000	30-80% of landscape	[33]
Old growth, current	Ash	1,886-4500+	VF estimate from age v area graph (SF only)	[16,77]
Timber Harvesting Exclusion Zone (THEZ) - 200m buffer around verified LBP records. For each 12.6 ha buffer, VF calculated loss on average of 2.8ha of harvestable forest. Baker et al (2017) [60] estimate 9.5ha loss of harvestable forest when located in 1939 regrowth.				
650 x 12.56 ha6 ha LBP THEZ	All land types	8,160	Maximum area assume no overlap	
650 x 2.8ha harvestable	Ash	1,820	Av. loss per LBP buffer	[77]
650 x 3.7 young forest	Ash	2,400	Av. loss per LBP buffer	[77]

[1] The area for these calculations are a square area placed over the Central Highlands region for environmental accounting. They are not RFA or FMA boundaries.

[2] VEAC reports this as area of forest burned but references Cruz et al 2012 [76] which refers to all land (including cleared land).

[3] This figure seems very high (should be a subset/smaller than 68,000 ash + Snow Gum). VEAC report attributes this claim to Cruz et al 2012 [76], but the area of ash burnt is not reported in that paper. It remains unclear from where this figure is sourced.

[4] Baker et al. (2017) [60] estimated ash losses to fire (20% in 20 years) and climate change impacts (15% reduction in yield, 80% reduction in area able to naturally sustain ash), but failed to translate this to actual hectares of forest. We have multiplied their estimates by the total area of 'available' and 'suitable' ash in the 3 FMA regions that make up the Central Highlands (87,000 ha) in an attempt to estimate losses and give context to the area affected by LBP buffering. Note, the area of 'available' and 'suitable' ash includes all age classes, not just 1939, these figures have been used as the losses should be accounted for over a full rotation.

Table 5.2: Volume of wood products

Description	Wood type	Volume (m^3/yr)	Notes	Source
2009 Sustainable yield	All species	324,000	D+ sawlog, Central Highlands	[78]
	Ash	254,000	D+ sawlog, Central Highlands	
2013 Sustainable yield	Ash	220,000	D+ sawlog, statewide	
2016 Sustainable yield	Ash	175,000	D+ sawlog, statewide	
2016-21 Sustainable yield	Ash	153,000	D+, statewide	
2021 onwards Sus. yield	Ash	132,000	D+ sawlog, statewide	[77]
2013 to 2017 reduction of 88,000m^3/yr due to FHEZ	Ash	22,000	Current LBP protection	
VicForests estimated adjustments to timber volumes 2013 to 2017, actual losses				
GMZ to SPZ due to FHEZ	Ash	7,000	Based on 518 LBP records	[2]
Fragmentation losses	Ash	10,000		
Available forest that is of 'high interest'	Ash	7,000	Around tourism hotspots?	
Old growth buffering	Ash	12,000		
Updates to forest zoning	Ash	5,000		
Total area of adjustments	Ash	45,000		
VicForests estimated adjustments to timber volumes 2013 to 2017, forecast future losses				
GMZ to SPZ due to FHEZ and fragmentation	Ash	18,000		
Access restrictions due to colony locations	Ash	16,000		
Introduction of VR harvest	Ash	9,000		
Total area forecast losses	Ash	43,000		
VEAC (Baker et al, 2017) estimated adjustments to timber volumes				
VEAC estimated loss due to LBP buffers (including estimates of future colonies yet to be found)	Ash	48,800	All directly attributable to buffers (fragmentation would be additional to this), 4921ha, losses averaged over 22 years	[60]
Current pulp wood contracts	Ash	265,000	AP contract until 2030. Native forest provides 34% of AP feed, plantations 57%, recycled fibre 9%	
VEAC estimate, loss due to LBP buffers	Ash D+ sawlog	1,075,177	Modelling by Baker et al, based on estimated future 518 sightings in 1939 age forest	[60]

There are some **important conclusions** to be drawn from the data shown in Tables 5.1 and 5.2.

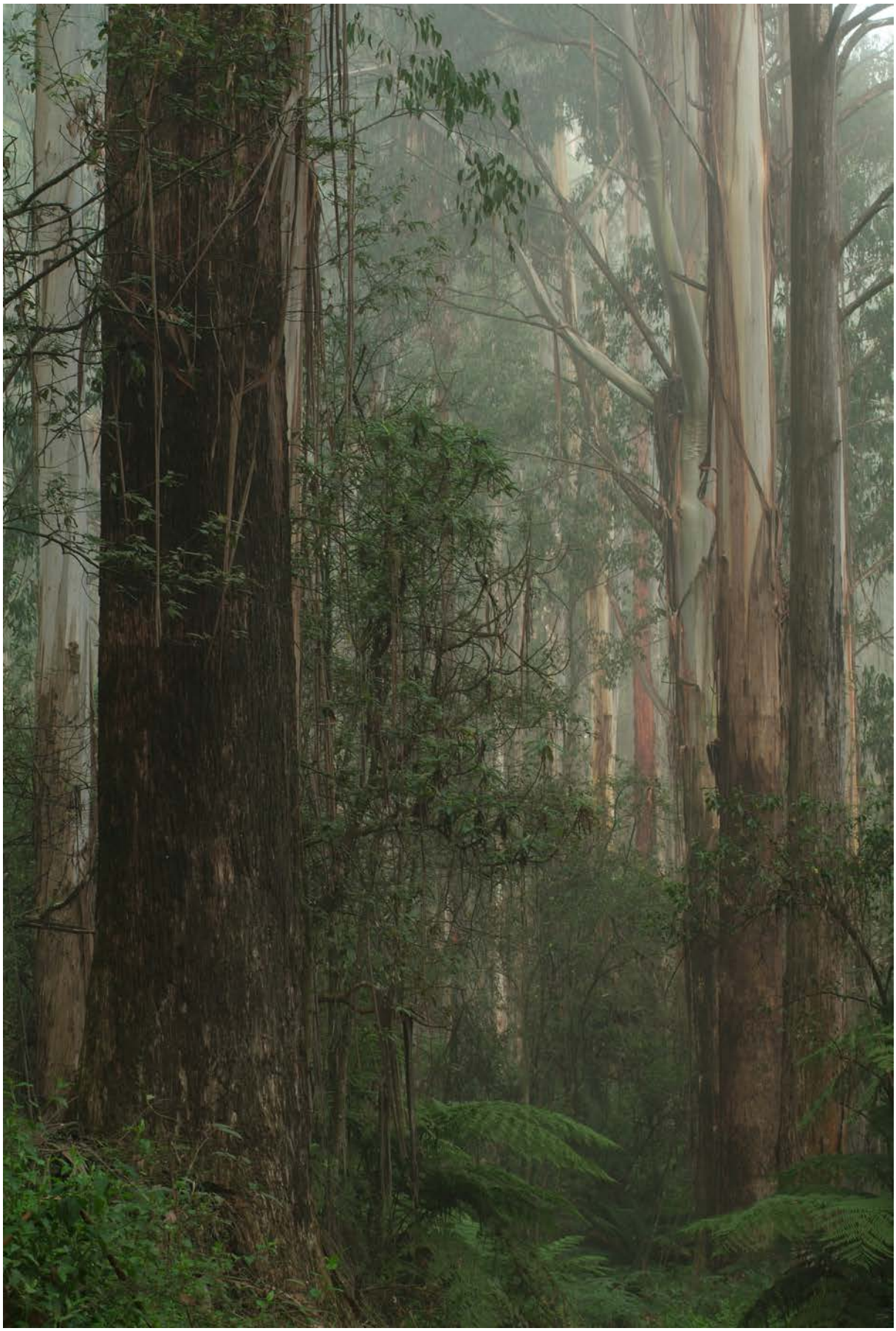
The overall age of the forest is very young. Figure 5.2 shows that only approximately 30-35% of State forest is older than 60 years. This is problematic for a number of reasons. The timber industry has suffered large sawlog reductions and there is insufficient standing volume to meet contractual demand from saw mills [79]; there are only very limited areas of old growth remaining and hollow-bearing trees (that many species require) are in rapid decline [21]; young forests grow quickly and this leads to reduced water yields for other users [46]; these forests store far less carbon [47] and are prone to burning at higher severity [48] than older forest.

As previously discussed in Chapter 3, LPAG Recommendation 7 was to achieve a minimum of 30% of the Mountain Ash forest estate in each Leadbeater's Possum Management Unit reaching the old growth age class. Because there is currently very little old growth across the landscape, we look to the next oldest forest, that which is currently closest to attaining old growth status, to fulfil this target. Figure 5.2 shows the next oldest forest is the 1939 age forest – currently nearly 80 years old. However, only 30-35% of the Mountain Ash estate is currently of this 1939 age, which means that **if these targets for old growth are to be met, all remaining 1939 aged forest must remain unlogged**. **In some Leadbeater's Possum Management Units there is already less than 30% 1939 age or older**, so we have missed the target already and due to the lack of forest that regenerated in the 1940-1960s (Figure 5.2), the 30% old growth target is now unachievable in those areas before the end of this century. With the likelihood of additional fires over the next 50 years, it will be very challenging to achieve the minimum 30% old growth target, but ongoing logging is guaranteeing that these targets are not achievable within the next 100 years.

Climate change and fire will have a far greater impact on future sustainable yield than the current buffers aimed at protecting Leadbeater's Possum. Based on modelling completed for VEAC by Baker et al [60], fires are likely to burn 17,400 ha of 'available and suitable' ash in the State forest of the Central Highlands in the next 20 years, and climate change could cause losses in excess of 69,600 ha of 'available and suitable' ash over a single rotation of 80 years. In comparison, the Leadbeater's Possum THEZ buffers are estimated to affect 4,921ha.

Some of the losses blamed on the introduction of Leadbeater's Possum buffers are due to other factors. Regulatory changes have included buffering old growth, protecting forest in high interest areas and introducing variable retention harvesting. All of these protective measures or improvements to practices should have been implemented whether Leadbeater's Possum was present or not.

Pulpwood supply will drive harvesting in these forests until 2030. With reductions in sawlog supply, but no reduction in the amount of pulpwood supplied under contract with Australian Paper, the ratio of pulp to sawlog is increasing and additional wood fibre will need to be sourced specifically to supply Australian Paper. This is likely to come from environmentally damaging thinning operations which have negative impacts on midstorey and understorey plant species. Because thinning does not produce sawlogs, it is usually ignored in calculations of sustainable yield. Thinning further simplifies forest that has already been simplified due to clearfell logging [80]. Thinning also makes the forest more fire prone due to increased fuel at ground level including dead material, drier ground fuels due to increased light penetration and greater air movement, and the open structure allows greater wind speeds within the thinned stand, which drives more intense fire behaviour [53,54].



Mountain Ash forest at Toolangi (Photo: D. Blair)

Chapter 6: Mountain Ash as a Critically Endangered ecosystem

Key points

- Mountain Ash forest has been subject to a formal IUCN Red List of Ecosystem assessment. It was classified as Critically Endangered (CR) in this assessment (Burns et al. 2015). This assessment does not mean Mountain Ash as a species will cease to exist, nor that areas with Mountain Ash trees will no longer be present. The assessment is about the ecological functioning of the Mountain Ash ***ecosystem*** as a whole and whether it supports the structures and abiotic processes that will allow it to continue to sustain the current biological diversity found within this forest type.
- The Critically Endangered status of the Mountain Ash ecosystem corresponds to its high risk of ecosystem collapse. The main reasons for 'ecosystem collapse' are the loss of old growth and severe reduction in the number of hollow-bearing trees – the key habitat resource for many species.
- Unlike many forest ecosystems, the overall area of Mountain Ash forest has remained stable over the last 50 years; land clearing for conversion to other land uses is not the major threat to this forest.
- Fires, logging and climate change and feedback interactions between those three key drivers have reduced the coverage of old growth and number of HBTs, and continue to do so.
- Climate change effects are already occurring, with increased seedling mortality at lower elevations [81], and increased mortality of old trees [22]. Modelling of future coverage of Mountain Ash forests (e.g. using BIOCLIM) show dramatic decreases in the area supporting this tree species [59].
- **Over the next 50 years, under a wide range of modelled scenarios, there is a ≥92% chance of ecosystem collapse, as defined by the IUCN Red List criteria** [44].

The Mountain Ash ecosystem supports the world's tallest flowering plants and has long been valued for its timber and water values [82] as well as its scenic beauty, recreational opportunities and wildlife [83]. In 2014, Burns et al [44] reviewed the ecosystem against the IUCN Red List of Ecosystems criteria. The criteria are based on change since 1750, change in the last 50 years and expected change over the next 50 years. The findings were:

(Note: LC = Least Concern, VU = Vulnerable, EN = Endangered, CR = Critically Endangered)

- Criterion A: Decline in distribution. Based on change in distribution in the past (none) and predicted change in the future (none), therefore rated **LC**.
- Criterion B: Restricted geographic distribution. Due to overall area, rated **LC**. Due to area not being spread geographically in many distinct patches, rated VU**. Due to fire being able to burn a large proportion of the ecosystem in one event** (as occurred in 1939), despite ability to regenerate, the simplification this brings meets criteria for rating of **EN**.
- Criterion C: Decline in abiotic processes (environmental degradation) due to climate change and shifts in the climate envelope. Historic changes in rainfall and temperature, rated Data Deficient. Modelled changes (using IPCC emission scenarios to predict losses of extent, estimated loss 14-100%, rated LC to CR), overall rating **VU**.

- Criterion D: Environmental degradation. **Based on the collapse of hollow-bearing trees** (see Figure 6.1) **and low levels of remaining old growth forest**. Estimated proportion of Mountain Ash that was old growth in 1750 was 30-60% (47,000–94,000 ha), in 1964 was 4% (6,300 ha) and reduced to 1% (1700 ha) currently. To be considered as having reached a state of ecosystem collapse, old growth needs to diminish to 1,400 ha or 0.9%. Given the likelihood of reaching that level in the next 50 years, the rating was **CR**. **Loss of HBTs** also rated **CR** with the number of HBTs/ha modelled, falling from 3.77/ha in 2011 to 0.29-0.82/ha in 2067, depending on fires and logging impacts over that period. The best case scenario assumes no fires and no logging. Ecosystem collapse is considered to have occurred at <1 HBT/ha. Even if this was adjusted to 0.5 HBT/ha, it would still be rated **CR** for this metric.
- Criterion E: Relative severity. Overarching analysis of likely collapse under different scenarios (fire, climate, logging). Modelled 39 different scenarios and ran 10,000 simulations. The **Mountain Ash ecosystem has, on average, a ≥ 92% chance of reaching 'ecosystem collapse'** (as defined by losses of old growth and/or HBTs) over the next 50 years. This rates as **CR**.

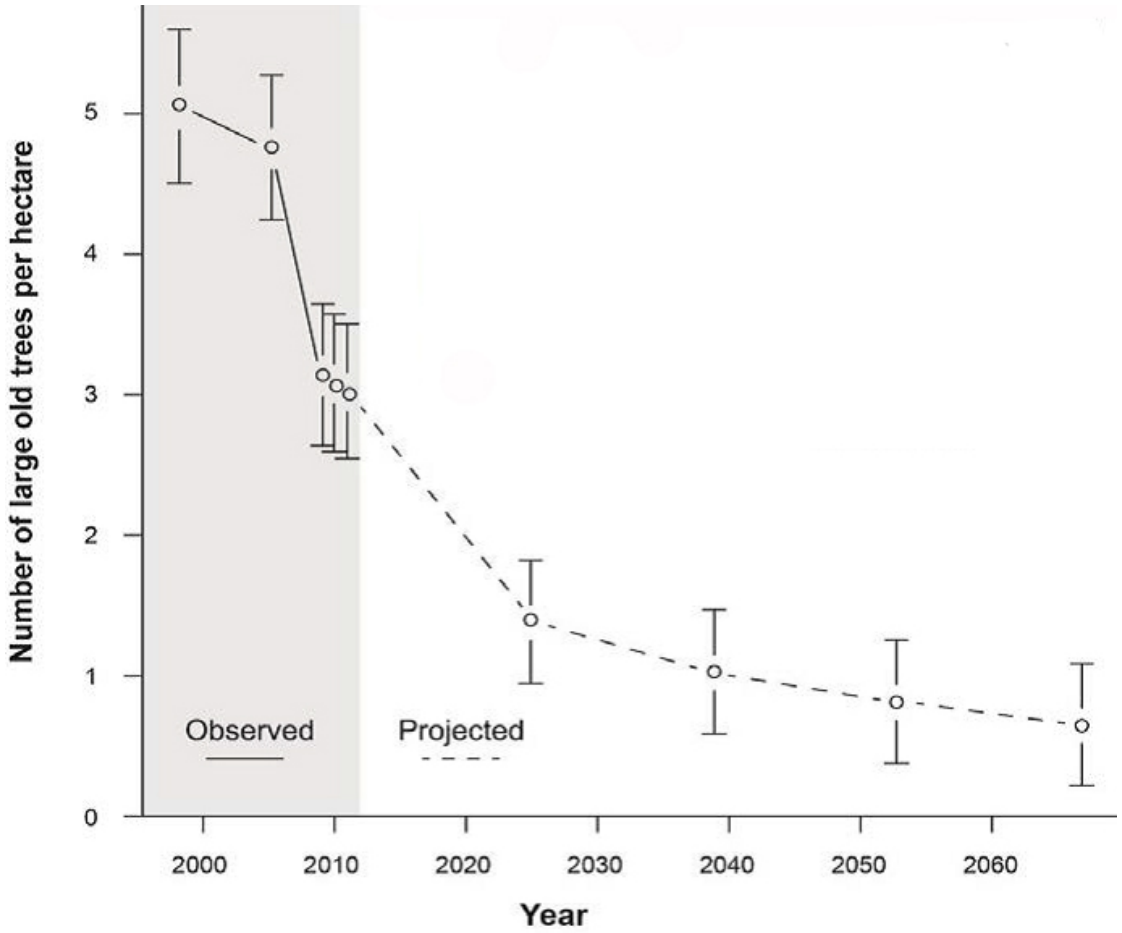


Figure 6.1: Decline of large old hollow-bearing trees, measured and modelled. Large old trees are in rapid decline and projected to continue trending down until stands of 1939 age forest begin senescing, around 2070. This graph has been modelled with the assumption of no fires and no logging until that time (neither assumption is at all likely to be correct in reality). Current logging regimes and any future fires will deflect the projection even lower (Source: [3])

Chapter 7: Leadbeater's Possum related reports and documents

Documents reviewed

- 2013 VicForests, Growth stages of ash eucalypts [84]
- 2013 DEPI, Maturity assessment of Mountain Ash, Alpine Ash and Shinning Gum [85]
- 2013 ARI, A new strategic approach to biodiversity management (occupancy model) [18]
- 2013 VicForests, Field guide for the identification of Leadbeater's Possum habitat [86]
- 2014 DEPI, Action Statement No.62 Leadbeater's Possum *Gymnobelideus leadbeateri* [61]
- 2015 DELWP, Threatened Species Survey Standard, Leadbeater's Possum, April 2015 [87]
- 2017 VEAC, Fibre and wood supply assessment report and Consultants' report [45,60]
- 2017 DELWP, A review of the effectiveness and impact of establishing timber harvesting exclusions zones around Leadbeater's Possum colonies [2]

Summary of key points

General points

- Scientific rigour of many government reports is limited due to a lack of peer review.
- Statistical methods being used and assumptions underlying models are often poor.
- Documentation following LPAG often lacked input from experts and in many instances, made the effective conservation of Leadbeater's Possum more difficult to achieve.
- While protection of individual animals is welcome, overall habitat protection is still the most important strategy, particularly the protection of large old trees.

Survey standards

- Current survey methods (camera traps, active search and call playback) are effective for detection, however, results are difficult to interpret for longitudinal population estimates and time series trends or understanding habitat use. Stagwatching data are better for these purposes.

Occupancy model

- The occupancy model developed by ARI is useful as a general starting point for targeted surveys, but the model is being used well beyond its appropriate level of applicability in a wide range of situations.
- Accurate modelling of Leadbeater's Possum presence is difficult without a HBT GIS layer.

Growth stages/Maturity assessment of ash

- Both 'mature' and 'old growth' stages have been truncated from long established and widely accepted definitions.
- New definitions excluded 1939 age trees from Zone 1A assessment.

New DEPI Action Statement (2014)

- Process very poor and excluded most experts. It is based on compromised LPAG recommendations and makes protection more difficult in many cases than previous Action Statement.

VEAC Fibre and Wood Supply Assessment

- Models maximise yield. Logging of 1939 aged forest is drawing to a close because of a lack of resource, the collapse of the sawlog industry is expected.

- Pulp agreement will drive logging (due to the collapse of the sawlog resource, pulp will no longer be residual to sawlog). Logging specifically for pulp has no social licence.
- Predicted losses of timber due to LBP buffers are small relative to losses from fire or climate change.

Review of THEZ buffers

- Buffers are positive, but conservation value is overstated and effectiveness unknown.
- Too much emphasis placed on gaining an accurate estimate of total population size while population trend, which is of greater importance, is being ignored.

2015 Threatened Species Survey Standards: Leadbeater's Possum *Gymnobelideus leadbeateri*

Key points

- Different survey methods are useful for analysis in different ways.
- Call playback and camera traps are useful for detection of animals, but this may alter possum behaviour and 'draw' animals beyond normal home range.
- Call playback is not repeatable. Few subsequent detections occur in follow up uses of the method.
- Interpretation of data from call playback and camera traps is difficult for population estimates and particularly for estimating population trend data.
- Stagwatching is non-invasive of the animal's behaviour, is repeatable and when combined with habitat information is powerful for analysing population trends (particularly given it is a standardized method that has been applied for ~35 years).

A set of survey standards was produced in 2012 [88] and updated in 2013 [42] and again in 2015 [87]. The standards detail the common methods used to detect Leadbeater's Possum and outline survey protocols and the required evidence needed to achieve a 'verified' record.

Sightings in areas other than State Forest require a less rigorous level of verification to be accepted as a record in the Victorian Biodiversity Atlas, while sightings in the State Forest have a far higher level of evidence required for acceptance.

These survey standards are part of a significant shift in focus regarding Leadbeater's Possum protection. While the increased protection of known individuals since 2014 is welcome (and was overdue), there is concern regarding the lack of measures which increase protection of habitat, in particular large old trees.

This standard builds on several problematic areas discussed elsewhere in this report, including Zone 1A changes (see Chapter 3, LPAG recommendation 6) and maturity assessment of ash (see below).

There are **several different survey methods** referred to in the standard and they differ fundamentally between those that change the animal's behaviour through responding to alarm calls (call playback) or being lured by baits (camera traps), and those where natural behaviour is observed unaltered (stagwatching). Altered behaviour through call playback is acceptable for detecting Leadbeater's Possum in areas where they are not otherwise known to occur. However, due to problems of repeatability (which is not acknowledged in the standard) and an unknown survey radius, interpretation of data from call playback is very difficult. Camera traps are far less intrusive

and disruptive, yet interpretation of results beyond presence/absence is still difficult and the level of repeatability for time series data is unknown [89].

Stagwatching remains the most reliable, most repeatable survey method which allows interpretation of long term trends and better interpretation of habitat interactions due to observations of the species behaving naturally within a defined area. If combined with habitat surveys of the area, this can lead to strong interpretation of possum-habitat interactions. Despite this, the survey standards suggest using cameras and call playback in conjunction with stagwatching.

The survey standards confirm current protection for "**pre-1900**" trees. This rule was implemented prior to 1994 [9] when pre-1900 trees were less than 100 years old. Currently under this rule, it is permissible to cut 117 year old trees. **The rule to prevent cutting of old trees must be updated to an age-based assessment (100 years being the most logical) rather than one based on a date**. An alternative would be to base the assessment on diameter (DBH), this would be far simpler to determine in the field rather than the difficulties of estimating age. Based on growth models [90], a DBH of 1.2m would be about the equivalent of a 120 year old tree, and so would seem appropriate, as earlier research indicated that 120 is the age at which Mountain Ash trees first begin to develop cavities [91].

2013 A new strategic approach to biodiversity management – Research component: occupancy model

We have **reviewed only one component of this report, the occupancy modelling** (Fig 4, pg. 15), showing where the modelling done by ARI predicts Leadbeater's Possum are <30%, 30-50%, 50-65% and >65% likely to be present across the landscape [18] (reproduced as Figure 7.1 below).

Key points

- The occupancy model is useful as a general indicator of where Leadbeater's Possum may be, but is unlikely to be sufficiently accurate to be relied upon as an alternative to actual field interpretation and surveys.
- Subsequent field surveys found that the areas predicted by the model to be 30%-50%, 50-65% and 65-95% likely to support LBPs were all equally likely to have LBPs present.
- The areas predicted to support LBPs (30-95%) are more likely than where the model predicted presence of LBPs to be 0-30% likely.
- The occupancy model is being used beyond its accuracy limitations in a wide range of government and non-government uses.
- Accurate modelling of LBPs is difficult due to the lack of a GIS layer for hollow-bearing trees.

Since it was completed, this modelling has been used in a wide variety of ways. It was initially used to determine which forest should have delays on logging applied through the LPAG recommendation 2 (see above), but has since been used in a variety of situations where planning is conducted in relation to Leadbeater's Possum habitat including broad use in the most recent report, 'A review of the effectiveness and impact of establishing timber harvesting exclusion zones around Leadbeater's Possum colonies' [2]. Private consultants have also used the occupancy model, with the assumption it is accurate, resulting in areas of likely LBP habitat not being identified or surveyed.

Widespread use of this modelling (particularly by people external to ARI) is problematic as it **is often used without a good understanding of the underlying assumptions and therefore the limitations of the model**. The model is useful as one of many information sources which may indicate where Leadbeater's Possum could be found. It should not be used as the sole source of information, with the assumption that the model has a high level of accuracy, negating the need for further investigations.

As has been long established in the literature, the most reliable covariate to describe where Leadbeater's Possum is likely to occur is the presence of hollow-bearing trees and dense midstorey, particularly of wattle [41,63,67,92,93]. Unfortunately, a spatial layer for HBTs is not available for the State Forest areas, so the ARI occupancy model has used other, indirect (and potentially less reliable) environmental covariates including the 'Topographic Wetness Index' (TWI). Areas in the landscape that have high TWI scores often do have a higher proportion of HBTs due to those wetter areas being less likely to burn, but there are many exceptions to this general relationship.

The Victorian Biodiversity Atlas map (reproduced here as Figure 7.2) shows areas where the model predicted that LBPs are very likely to be present (pink polygons = >65% likely), and where actual LBP records have been recorded (closed cross pre-2014 records, open cross post 2014 records). As can be seen, there is not a strong correlation, indeed ARI found 35-50%, 50-65% and 65-95% categories equally likely to have LBPs present [72].

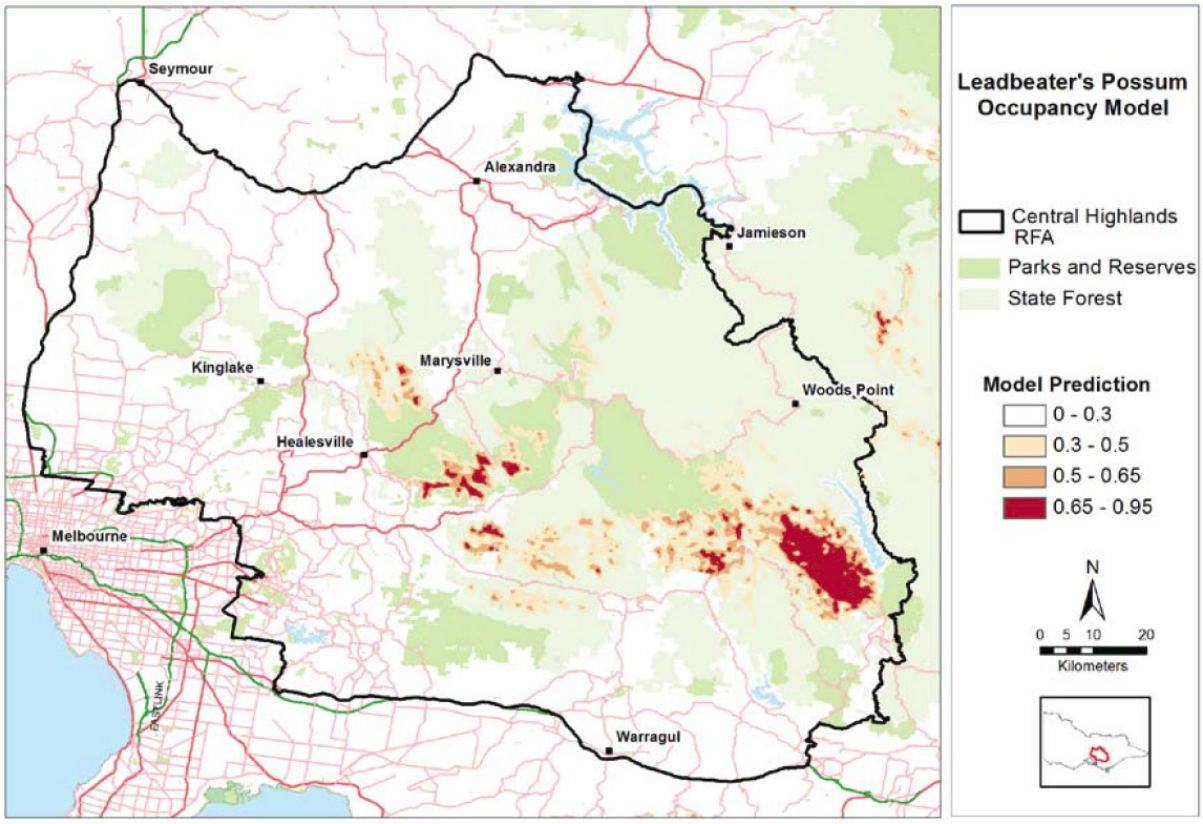


Figure 7.1: Occupancy modelling showing increasing likelihood of Leadbeater's Possum being present across the Central Highlands. Areas of darker red are modelled as having higher probability of the species being present (Source: [18])

The problem with this model is that **users do not understand (or are unaware of) its limitations**. They assume it is accurate and by avoiding areas on the map indicating Leadbeater's Possum presence, they assume they will be avoiding habitat that supports Leadbeater's Possums. As a result, consultants, forest managers and other planners are ignoring important consultation with experts in the department (or external experts) who could advise on whether specific areas were actually likely to support Leadbeater's Possum or not. Instead they are simply relying on this map, which may be inaccurate for the area under consideration.

The occupancy model is also being used extensively to review the effectiveness of the Timber Harvesting Exclusion Zones (THEZ). Given the correlation between environmental variables and possum presence is of only moderate strength, it makes drawing any statistically significant conclusions based on this model unreliable.

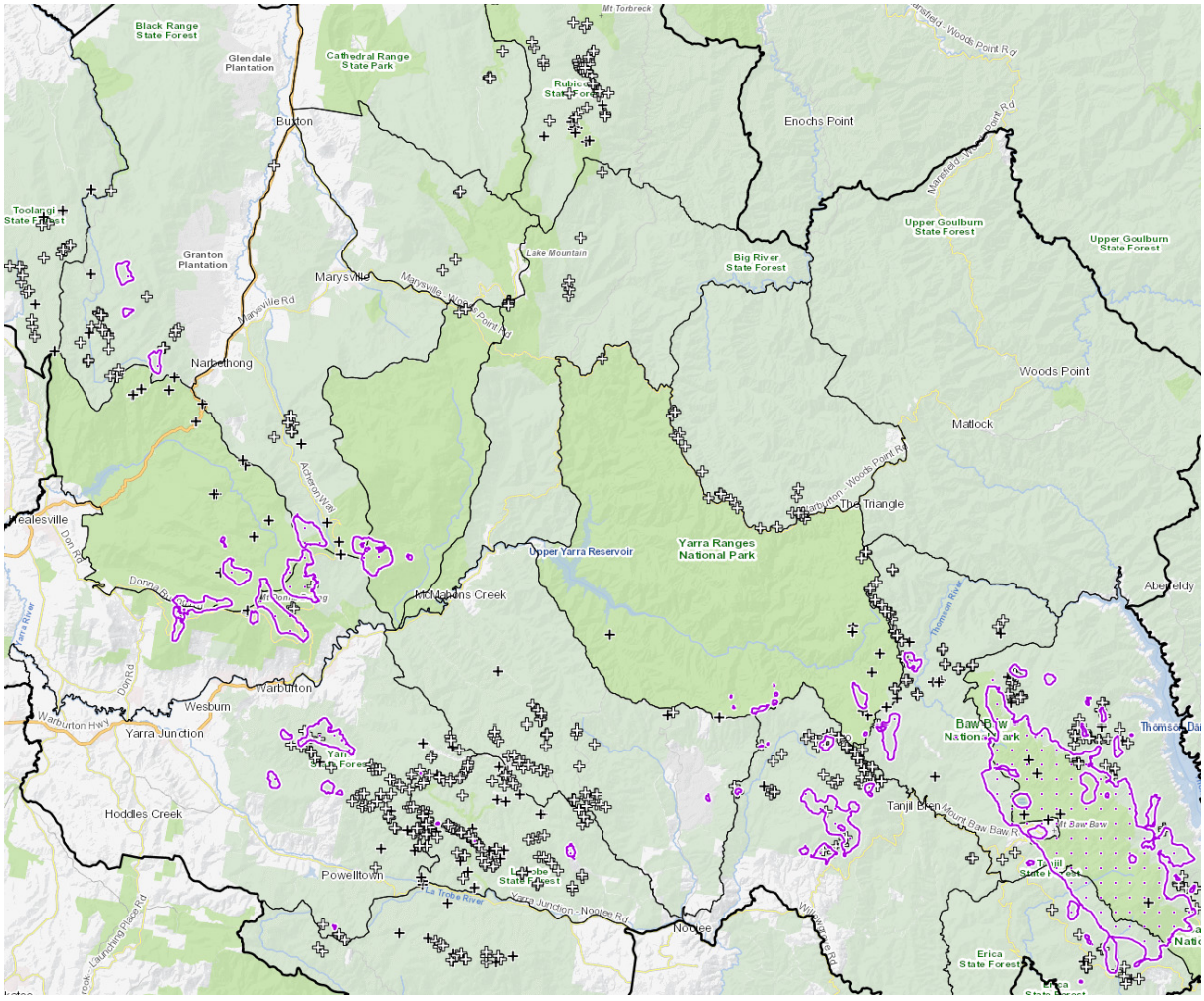


Figure 7.2: Map showing areas where the model predicted that LBPs are very likely to be present (pink polygons = >65% likely) (as per Lumsden et al 2013 [18]), and where actual LBP records have been recorded (closed cross pre-2014 records, open cross post 2014 records) (as per Victorian Biodiversity Atlas [94]).

2013 Growth stages of ash Eucalypts / Maturity assessment of Ash

Key points

- The range of ages covered by the definition of a 'mature' tree was truncated following the *MyEnvironment v VicForests* court case to exclude younger ages, including the 1939 cohort.
- Long held definition of a 'mature' tree being large enough to cut sawlogs from (for ash, 60-80+ years) changed to include only those trees that are 'ecologically mature', >120 years and senescing.
- Definition change has removed the need to assess any 1939 age trees for hollows as they are now excluded from LBP Zone 1A assessment.
- ARI found there were more trees younger than 120 years with hollows (which they called form '0.5') than 'stag form' 2, 3, 4, 5 or 8 in their assessment of 148 sites supporting Leadbeater's Possum [2], these are the kinds of trees the new mature definition explicitly removes from 1A assessment.
- Could have implications for protection of old growth as this definition has also been truncated on the younger end by approximately 100 years.

Definitions are a fundamental part of laws and prescriptions relating to forestry. They describe forest characteristics and how these relate to those prescriptions. Mountain Ash tree growth along an age continuum, from seedling to old growth, will vary due to differences in environmental conditions on different sites, but average growth rates for Mountain Ash are well established. Commonly used terms have varied between forest areas and authors, with some terms used interchangeably or in more general ways. For example, all ash forest could be termed 'regrowth' as it regrows following disturbance and depending on context, 'mature' may mean sexually mature (capable of seed production, 15+ years), capable of producing sawlogs (70+ years old), ecologically mature (120+) or 'over-mature' (200+).

The '**stages of growth' of eucalypts were described by Jacobs in 1955** [95] and this was the widely accepted definition amongst most professional foresters. Jacobs' diagram (see Figure 7.3) included six trees with the first two being 'regrowth', the middle two were 'mature' and the final two describing senescence or old growth. For the foresters of the 1950s, a 'mature' tree was one that would yield a sawlog, but was also used for any tree older than this. Hence, while a senescing tree was one that was beginning the transformation to old growth where hollow development generally begins, authors including Ashton, referred to 'mature' forest ranging from the younger stands out to those over 200 years old [96]. The Commonwealth Government Comprehensive Regional Assessment for the Central Highlands, completed just prior to the RFA being signed, considered 'mature' forest to be 80+ years and 'over-mature' trees to be those exceeding 120 years old [9].

Following the *MyEnvironment vs VicForests* court case, the Department and VF sought to clarify 'mature and/or senescing' trees as described in the Leadbeater's Possum Zone 1A prescriptions. This resulted in a **truncation of the range of ages covered by the term 'mature' so it referred only to old (120+ year old) trees rather than including the younger (sawlog ready) trees**. The new diagram from their reclassification [84,85] now has 7 trees represented, with an additional tree in 'regrowth' (see Figure 7.3). The new descriptions no longer recognise the gradual transition and natural variation of the species from one form to another, instead having strict age cutoffs.

This is problematic because not only does it now exclude all hollow-bearing trees younger than 120 years old from being considered as part of Zone 1A (while uncommon, such HBTs certainly do exist; ARI even created a new form class of '0.5' for these trees [2]), but also because 'mature' has been extended, an additional effect is that it also truncates the younger end of the definition of 'old growth' from trees 120-150 years old (when senescence typically begins) to trees over 250 years old. The result is any restrictions that apply to protect 'old growth', now have an additional century of growth required before such prescriptions take effect. This is a major issue given how little old growth forest currently exists [16].

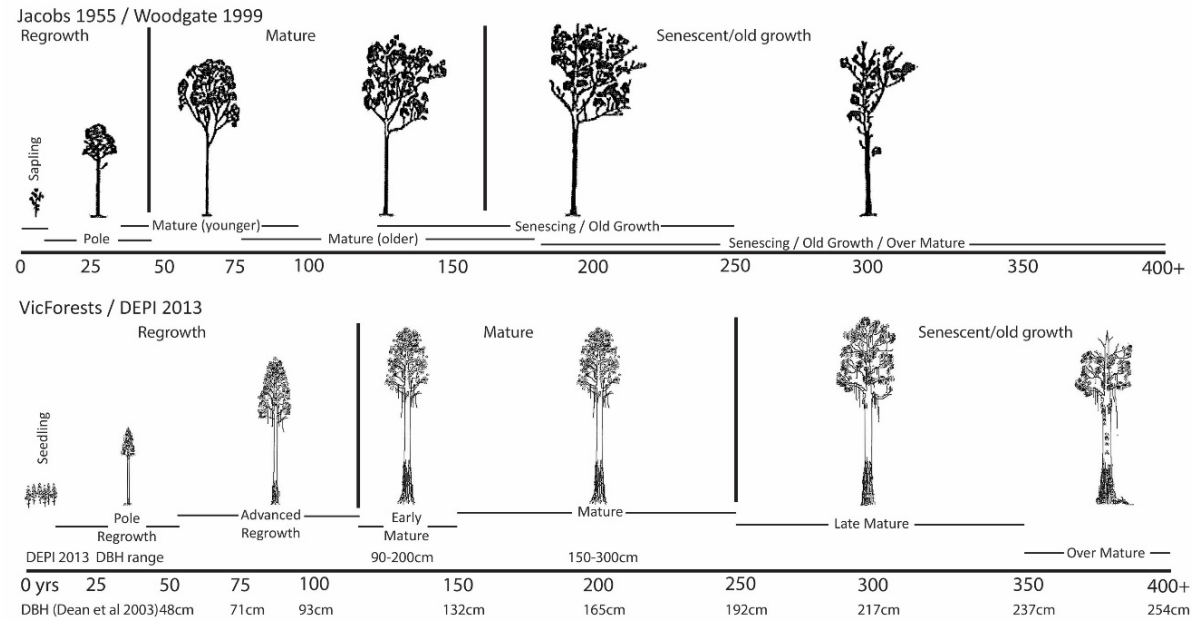


Figure 7.3: Stages of growth of Mountain Ash showing definitions from Jacobs (1955, top) and VicForests (2013, bottom). At the bottom below the line are average DBH measurements from equations produced by Dean et al 2003 [90], which can be contrasted to typical DBH measurements suggested by DEPI in their new definitions (above the line). Note the overlap of definitions for Jacobs, while the VF definitions have clearly defined start and end ages. (Source: [33])

2014 Action Statement No 62. Leadbeater's Possum *Gymnobelideus leadbeateri*

Key points

- The process to write the new DEPI Action Statement (2014) [61] was poor. Experts who have studied the species for decades and members of the Recovery Team who had worked towards a revised Action Statement for several years were not involved.
- The new DEPI Action Statement was based on LPAG recommendations which were compromised due to restrictive terms of reference.
- Despite Leadbeater's Possum being more endangered now than it was when the original Action Statement was written in 1995, several sections of the new Action Statement make protection of the species more difficult.
- A full review of the Action Statement should still occur with the National Recovery Plan 2016 [55] providing guidance.

As a species listed under the *Flora and Fauna Guarantee Act 1988*, Leadbeater's Possum requires an Action Statement, which should be updated every 10 years. The original Leadbeater's Possum Action Statement was published in 1995 and a substantially similar version was published online in 2003. Following the 2009 fires, the Leadbeater's Possum Recovery Team finalised a new updated Action Statement in 2010, but this was never signed off by the Minister before the election in that year and was subsequently shelved. In 2014, following LPAG, the Department re-wrote the Action Statement. It is this document that we are reviewing here.

The **scientific and policy process under which the new DEPI Action Statement was written was problematic.** The new DEPI Action Statement was launched on 29 July 2014 at a small private function that excluded the community and many others who had worked on the species for many years. **It was written with no public consultation, and virtually no consultation with experts**, including the two main experts, David Lindenmayer and Dan Harley who had a combined experience of over 40 years on the species. The Department, which wrote the document, claimed sufficient consultation had occurred through LPAG, but LPAG also lacked input from external experts and ENGOs (see Chapter 3). It was particularly frustrating for the community ENGOs (Friends of LBP, Field Naturalists Club) who had been **working for several years within the Recovery Team** (along with all relevant Leadbeater's Possum experts) and had worked through an updated Action Statement, which was ignored.

The new DEPI Action Statement drew heavily from the outcomes of LPAG, which, as discussed in Chapter 3, was unable to consider the most important conservation actions due to the restrictive terms of reference.

There are many problems with the new DEPI Action Statement as a result of how it was written and who wrote it.

The new DEPI Action Statement failed to mention the proposed uplisting of Leadbeater's Possum to Critically Endangered (at that time under consideration by the Threatened Species Scientific Committee, and since accepted). There is a failure to recognise the main population of Leadbeater's Possum (in montane ash forests) is sub-divided by major roads, with some sub-populations under great pressure.

The new DEPI Action Statement does not acknowledge that thus far (post 2009 fires), **captive breeding and translocation** has made no contribution to conservation efforts – captive animals have failed to breed and indeed eight of 21 individuals have died as of July 2017. While Leadbeater's Possum has been successfully bred in captivity in the past (but not in the past decade), they have never been successfully released into the wild. Translocation has never been attempted.

The new DEPI Action Statement does not acknowledge that the **reserve system for Leadbeater's Possum has been found to be inadequate** by the scientists from the State Government [26] and, unlike the Australian Government's Recovery Plan [55], this Action Statement does not highlight protection of live and dead hollow-bearing trees as being a high priority, unless they are in sufficient density to trigger protection under Zone 1A and 1B or are found in old growth stands of 5ha or more.

The new DEPI Action Statement does not acknowledge that recent **definitional changes** make the conservation of Leadbeater's Possum more difficult. As discussed above, the definitional changes truncate the age range of 'mature' and 'old growth' trees [84,85] so that all trees of 1939 age are now excluded from assessment. The size of the hollow (>4cm) and height of the hollow on the tree (6-30m) as defined in the survey standards [87] (also discussed above) adds further restrictions which were previously absent.

2017 VEAC Fibre and Wood Supply Assessment Report (and Consultants' Report)

Key points

- The conclusion of harvesting of 1939 age forest was predicted to result in major structural change to the industry; that is now happening.
- Due to fires and logging, there are no major stands of forest of suitable age that can replace the sawlog resource within the next few decades.
- Current commitments to Australian Paper are for 265,000m3/yr of ash pulp from the Central Highlands until 2030.
- Sawlog yields are decreasing but pulpwood yields are not, therefore pulp is no longer just 'residual' volume from sawlog production and as a result, the industry can no longer claim to be sawlog-driven.
- Extensive thinning is likely to supply pulp, this is environmentally damaging and elevates the risk of fire [53,54].
- Losses due to Leadbeater's Possum buffers estimated to be 4,921ha or 1.7M cubic m of D+ grade timber.
- In the next 20 years, it is estimated that fire will burn 17,400 ha of 'available and suitable' ash.
- Climate change effects by 2080 estimate nearly 70,000 ha of currently 'available and suitable' Mountain Ash forest would be unable to naturally regenerate.
- Modelled climate change impacts would lead to total ecological collapse of the Mountain Ash forest ecosystems.

The **Victorian Environmental Assessment Council** (VEAC) was requested by the Minister for Energy, Environment and Climate Change to assess the current and projected wood supply from native forests in Eastern Victoria. The report draws together a useful summary of many current and future issues and constraints regarding wood supply, and examines specifically the effects of fire, Leadbeater's Possum buffers and climate change on wood supply.

A major issue identified for the Central Highlands ash forests is **the unbalanced age structure with the majority of forest now of very young age classes** with 65-70% younger than 60 years [45]. The conclusion of harvesting in the 1939 age forest was predicted to result in major structural change to the industry. This is now occurring. Due to fires and logging, there are no major stands of forest of suitable age that can replace the 1939 resource within the next few decades. Due to extraction of the easiest, most profitable areas first [45], the current stands being harvested are some of the more difficult to access or more controversial due to conflict with tourism, wildlife or other priorities.

The overall **decline in sawlog timber resources is a result of the Black Saturday fires and several decades of resource extraction at unrealistically high levels**. The resource modelling that is used by VicForests (models 'Woodstock' and 'Stanley' by RemSoft) predict volumes with high levels of accuracy and are efficient in extracting the maximum allowable volume from the forests. The problem is, in attempting to achieve maximum yield from the forests, **the model gives priority to contractual agreements** [45] that have over-committed the forest resource beyond where a more conservative level of harvest would account for actual resource availability and losses due to fire or other ecological requirements (such as protection of threatened species). The contractual demand arises not just from sawmills, but from pulplog contracts, which should have been residual to sawn

timber, but are now a major driver within the modelling, eroding future sawlog supply. A more conservative estimate of sustained yield would have allowed for the inevitable losses from fire and made provision for buffering Leadbeater's Possum records without it being in such direct conflict with contractual obligations. From an ecological perspective, this has resulted in over cutting of the forest as insufficient stands remain to meet old growth targets (see LPAG recommendation 7, Chapter 3) and ensuring even basic levels of protection of Leadbeater's Possum. **From VicForests' and the timber industry's perspective, the modelling does what it is set up to do, that is, extract the maximum allowable timber volumes from the forest**. The current decline in sawlog was entirely predictable, and is due to that process coming to an end in 78 year old forests being cut on an 80 year rotation.

Many of the issues covered by the VEAC wood supply report have already been discussed in this report, including area/volume analysis and problems with predominantly young forest (Chapter 5); the reduction of sustainable yield (Chapter 5); the LPAG recommendations (Chapter 3); and Leadbeater's Possum THEZ buffers review (below, Chapter 7).

The VEAC wood supply report provides an overview of state and national policy including the **Regional Forest Agreements** (RFAs). **The Central Highlands RFA** was brought into effect in 1998. The RFAs were to be reviewed every 5 years, but the first review was not completed until 2009 (which rolled the first two reviews into one), and the third is due in September 2017, only 6 months before the 20 year RFA is due to expire in March 2018. Whether the RFAs are renewed for another 20 years is currently being debated. What should not be questioned, however, is **if the RFAs were to be extended, there is need for major review and reform of the timber industry in Victoria**.

With the current trajectory toward rapid collapse of the sawlog industry in the Central Highlands and the greatly reduced yields that are expected from the diminishing resource, focus is turning to the volumes of pulplogs being extracted. Of the ash logs currently extracted, 43% are sawlog and 57% pulplog. Just under half of the sawlogs are structural or appearance grades B, C, D and just over half is non-structural E grade (mostly used for pallets etc.) (see Figure 7.4). The assumption is the industry is sawlog driven, so reported 'sustainable yield' describes only D+ sawlog. The problem is, that the calculations of sawlog volume currently ignore over 75% of log volume harvested – a ratio that is likely to worsen over the next decade due to the ***Forests (Wood Pulp Agreement) Act 1996***, signed by then Premier Kennett. This contract guarantees supply of **265,000m^3/yr of ash pulplogs to Australian Paper through until 2030** (see Figure 7.4). As discussed above in Chapter 5, due to reduced sawlog coming from these forests, harvesting specifically for pulp will now need to occur. All current sawlog contracts for the Central Highlands expire by 2024 [45]. **The logging of complex native forest ecosystems only for paper pulp is an action that is likely to have limited social license**.

In 2013, Australian Paper sourced pulplogs from plantations (57% of supply), native forest and mill waste (34%) and recycled fibre (9%) [45]. The Legislated Agreement relating to pulp supply to Australian Paper identifies an acceptable haulage distance which determines the 'Forest Area' where pulplogs can come from. As can be seen in Figure 7.5, the area effected is the forests of the Central Highlands and the majority of the distribution of Leadbeater's Possum. **This wood supply should be shifted to a plantation based resource as rapidly as possible.**

The VEAC wood supply report **compared the impact of bushfires, climate change and Leadbeater's Possum buffers on timber supply**. This was based on a separate analysis (Consultants' Report) done by Baker et al [60].

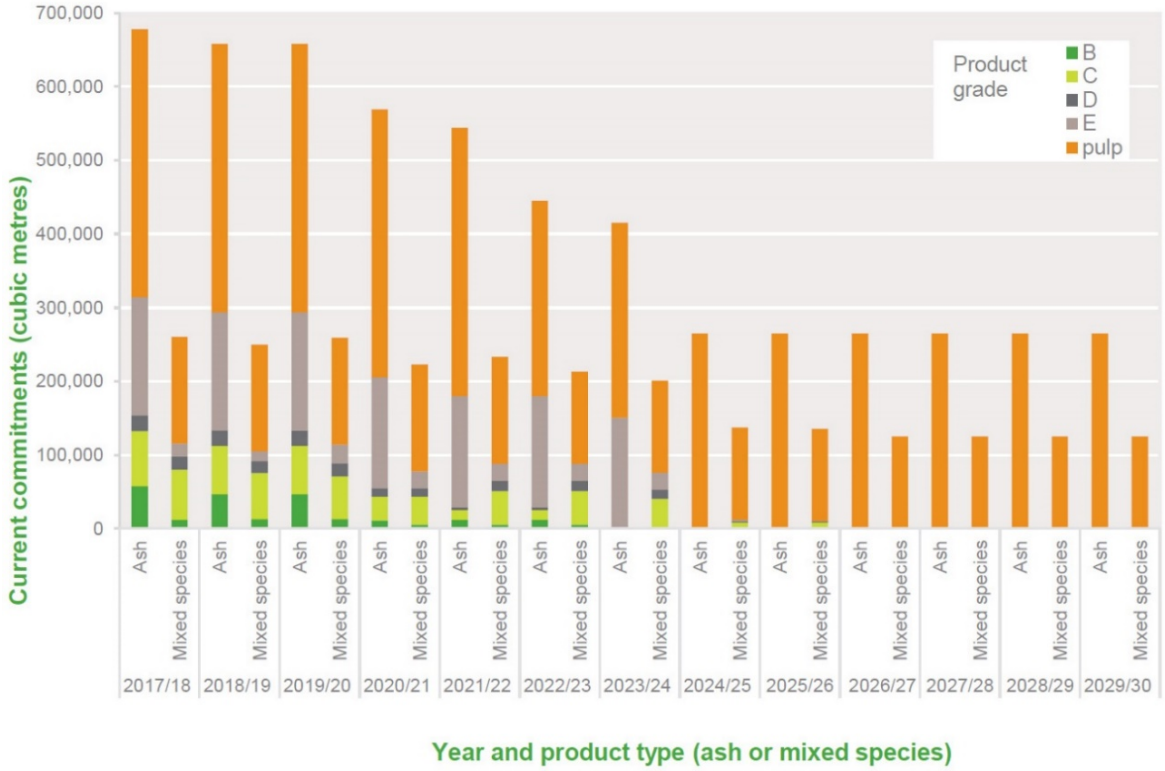


Figure 7.4: Current sawlog and pulplog commitments by product type and grade (Source: [45])

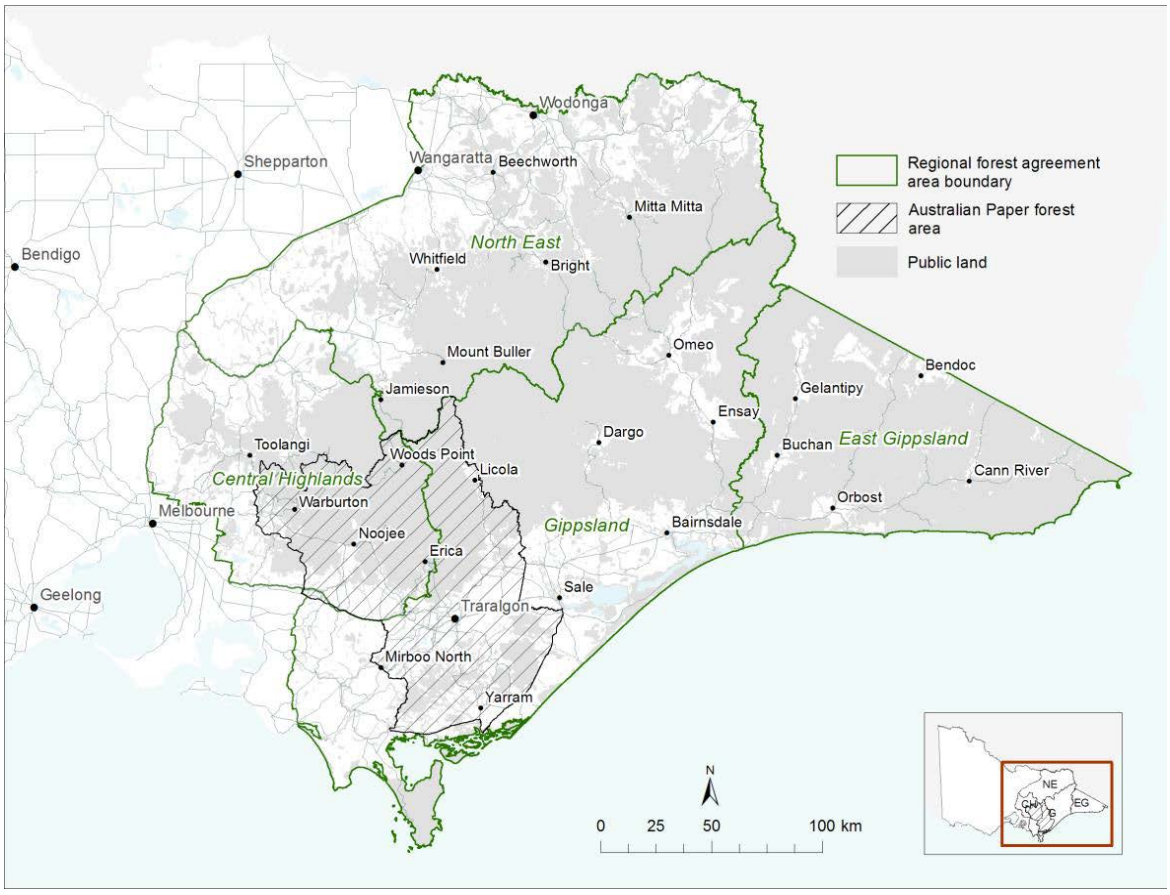


Figure 7.5: 'Forest Area' where Australian Paper native forest fibre must originate (Source: [45])

Bushfire was acknowledged as having a "profound effect on wood supply levels" with 34% of the Central Highlands having been burnt in 2009 [23] and 85% in 1939 [44]. When modelling fire frequency and scale, to predict future fire impacts, the consultants used information dating back to 1950, and thus excluded the very widespread 1939 fires from the analysis. Furthermore, the modelling did not account for increased fire risk in the future due to climate change which is likely to lead to greater areas burnt, although the model also assumed all burnt areas would be burnt at high severity (which is unlikely), leading to decreases in the estimate of lost volume. Baker et al predicted a loss of up to 20% of the ash resource due to fires in the next 20 years. Using the area of 'available' and 'suitable' ash (see Table 5.1) being 87,000 ha, 20% of this indicates an expected **17,400 ha to be burned in the next 20 years**. Baker et al concluded this "would be unlikely to eliminate the native forest industry".

Climate change effects were longer term and less certain but potentially far more serious. A 3°C rise in temperatures by 2080 would lead to two main effects, according to the modelling. One was a **reduction in stand volumes by 15%**. While this is significant, the far more important change was the **reduction in area that would continue to naturally support Mountain Ash forests**. Indeed, following the 2009 fires, our research showed the first signs of the effects of a warming climate, with natural ash regeneration failing at lower elevations [81]. The consultants' modelling indicated under a 3°C rise in temperatures, only the higher elevations would support natural regeneration of Mountain Ash (see Figure 7.6). The area modelled as suitable for Mountain Ash in 2080 currently has Alpine Ash or subalpine Snow Gum communities, and much of it is in National Parks such as Mt Baw Baw and Upper Yarra. Modelling also showed areas that could remain productive and continue to grow Mountain Ash if seedlings were hand planted (Figure 7.7).

Under the scenario of a 3°C temperature rise, a **reduction of over 80% of the current 'available' and 'suitable' area of ash would equate to 69,600+ ha**. The area of ash beyond these production forest areas would be far greater. Baker et al concluded the impact was a reduction in stand density and volume of 15% and the need to plant rather than seed areas when cut or burnt. **No mention was made of the risk of the total ecological collapse of the forest ecosystems involved**.

Leadbeater's Possum buffers around confirmed sightings also were analysed as a risk to wood supply. Like the occupancy model discussed earlier in Chapter 7 [18], the model estimating the likelihood of Leadbeater's Possum detection did not use habitat features, but rather the **less reliable covariates of stand age and elevation**. The model used ARI's survey data of 355 surveys with 134 positive detections, but then appear to assume that all forest areas were equally likely to have Leadbeater's Possum present at the densities which ARI had surveyed. This will not be the case as ARI's surveying had specifically targeted where Leadbeater's Possum was either already known to exist, or where they were very likely to be found. Baker et al then assumed 1240 Leadbeater's Possum confirmed detections would be made, with 518 of those in 1939 regrowth.

To calculate the area of available ash that would be reserved as a result of the buffers, Baker et al estimated a figure of 9.5ha per buffer. This seems high, when VicForests' modelling of actual current buffers showed 2.8ha of harvestable ash was associated with each buffer on average over all existing buffers. This figure would be expected to be higher in 1939 regrowth, but they do not explain how they derived the figure of 9.5ha. The area reserved as a result of the buffers was then calculated as:

518 sightings x 9.5ha/buffer = 4921ha, @218m^3 D+/ha = 1,753,678m^3

Rather than base this loss over the length of a logging rotation (65-85 years), the area was divided by 22 years, the remaining time before the 1939 age forest reaches 100 years. Why they chose this figure is difficult to understand as there is nothing currently to prevent the logging of any forest that regenerated after 1900 (except for patches of old growth). Discounting the rate over 22 years led to

the final figure of losses of 48,863m^3 D+ sawlog per year *directly attributable to area within the buffers*. In contrast, VicForests claims actual losses of 45,000m^3/yr due to existing buffers, but only 7,000m^3/yr of that attributed to areas within the buffers (see Chapter 5). The remaining 38,000m^3/yr was outside the buffers, but no longer accessible due to the buffers preventing access, or fragmentation making the area commercially unviable. Of the forecast additional 43,000m^3/yr that VicForests anticipate losing due to future sightings, only 18,000m^3/yr of that is attributed directly to areas within the buffers, the remainder being due to fragmentation and other buffering such as old growth. As a result, **the estimates within the VEAC report appear inflated**.

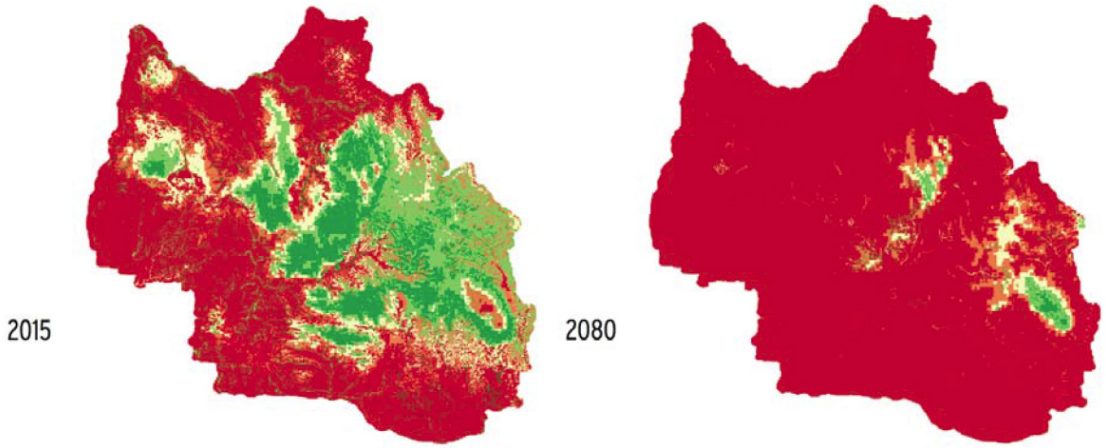


Figure 7.6: Mountain Ash natural regeneration suitability across the Central Highlands in 2015 (left) and modelled under 3°C warming in 2080 (right). Suitable areas are green, unsuitable are red. (Source: [60])

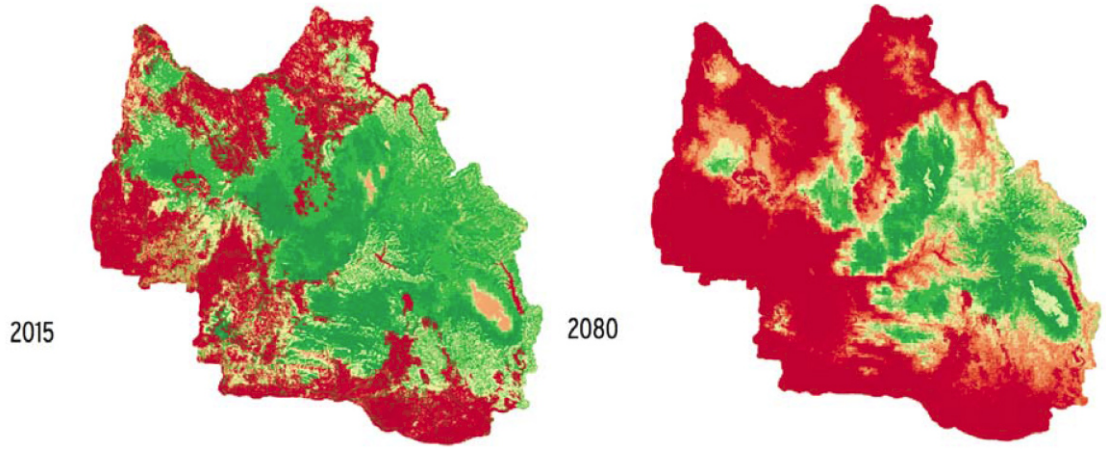


Figure 7.7: Forest productivity of Mountain Ash across the Central Highlands shows where Mountain Ash could be planted beyond where they would naturally be able to exist through generation from seed in 2015 (left) and modelled under 3°C warming in 2080 (right). Productive areas are green, unproductive areas are red. (Source: [60])

Even **if we assume the figure of 4,921ha reserved due to Leadbeater's Possum buffers is correct, this area is small compared to that likely to be affected by either fire (17,400 ha) or climate change (70,000+ ha)**. Through these calculations, it appears Baker et al have assumed all 'available' forest will be harvestable. However when drawing up coupe plans, exclusion zones are regularly established for a wide range of reasons; protection of threatened species is one of these. It should not be viewed as a 'loss', but rather forest that should be accepted as being unavailable.

Although the VEAC consultants' report details the 'losses' due to Leadbeater's Possum buffering to the level of each cubic metre of wood, the report fails to provide even broad figures on the comparable likely losses due to fire or climate change. This is curious given the **far greater magnitude of losses due to fire and climate change**, and presumably, greater impact on the industry. **The expected catastrophic ecosystem collapse predicted by climate change was not even mentioned in the Executive Summary** of the report from VEAC.

2017 A review of the effectiveness and impact of establishing Timber Harvesting Exclusions Zones around Leadbeater's Possum colonies

Key points

- Review of THEZ buffer effectiveness covers Jan 1998 to Jan 2017. In that time 820 verified records; 283 from 1998 – Feb 2014; 537 from March 2014 to Jan 2017.
- Report based on 436 records; 96 pre March 2014, 340 from March 2014 to Jan 2017.
- Far too much emphasis placed on estimating total population when population trend is far more important, yet this issue is barely mentioned.
- The effectiveness of the THEZ buffers through time is unknown, whether the protection they provide is adequate against the impact of logging, whether young can disperse etc.
- Current survey techniques (camera traps, active search, call playback) provide cross-sectional ("snapshot") information which is difficult to analyse for the most important metrics of population trend and ongoing effectiveness of buffers.
- Total population may be higher than previously estimated, but the population trend may not have changed, and is most likely to be in steep decline because it is tied directly to number of hollow-bearing trees.
- ARI hollow-bearing tree data from confirmed sighting locations confirms a large old tree crisis with very low numbers of dead or living HBTs found around known colonies.
- Many current colonies will not persist beyond the next decade due to HBT collapse.
- Protection for all HBTs was inadequately addressed, key habitat resource for many species other than Leadbeater's Possum, including the now vulnerable Greater Glider, other gliders, owls and many species of birds.
- Recruitment of HBTs is inadequately addressed; 1939 'next old growth' continues to be logged.
- THEZ buffers based around HBTs instead of sightings is likely to provide better protection in the long term.
- Phrasing within the review appears to confirm the inaccurate assumption by many in the forestry industry that Leadbeater's Possum is in recovery, referring to 'risk of extinction being reduced by 34%' (within reserves from a model that ignores fire), there being only a 'residual risk of extinction', and that new sightings 'cast doubt over previous population estimates'. ANU strongly advised ARI against making population estimates during LPAG as it is a distraction from major ongoing issues in the condition of the forest (the paucity of old growth forest and the loss of HBTs), yet this report mentions total population over 50 times and refers to the importance of finding overall population many times. This may delay meaningful action and important decision making while the quest for a total population figure takes precedence.

The **protection of known colonies of Leadbeater's Possum was a very positive outcome** from the Leadbeater's Possum Advisory Group process [23]. A buffer, or 'Timber Harvesting Exclusion Zone' (THEZ) of 200m was prescribed around verified records. This report reviews the buffers to assess their effectiveness and also to assess the impact they have had on timber supply.

Reported 'facts' relating to existing THEZ buffers (as of 1 January 2017) [2]

- Assume each verified sighting = 1 colony
- 820 verified records of Leadbeater's Possum in total, THEZ not placed around records areas that were burnt in 2009, those in areas already reserved or where multiples occur within close proximity; currently 436 THEZ buffers (as of 1 January 2017; see Table 7.1)
- Records collected by Government (ARI, DELWP, VF, ZV) 66%, community 30%, university 4%
- 99% of community records have been verified (1 was not)
- Nearly all recent records from surveys used active searches (call playback and thermal cameras) or camera traps
- THEZ buffers cover 1.9% (3,911ha) of 'potential habitat' in GMZ/SMZ areas of State forest
- THEZ buffers cover 2.5% (3,134ha) of total 'available resource' (all forest types), 91% is ash
- THEZ buffers cover 4.1% of ash forest within the available resource area
- THEZ buffers cover 2.4% (2,819ha) of '>30% likely' occupancy modelled area
- 2008 LBP reserve + THEZ now covers 46.3% of potential habitat and 40.8% of '>30%' occupancy modelled area
- Of 'total resource area' within the THEZ buffers, 37% (1,171ha) is 1939 age or 0.9% of the available resource (all ages) before the buffers were introduced
- Average State forest area (all ages of forest) = 9.3ha per THEZ
- 2008 LBP reserve = 30,520 ha
- Area in SPZ now due specifically to THEZ buffers = 4,046 ha

The **protection of known colonies of Leadbeater's Possums was an overdue reform** that was important. Prior to LPAG, protection was provided only through identification of very high quality habitat through the zone 1A/1B system which was technical and difficult to achieve, and failed to protect the vast majority of the population which lived in lower quality habitat. The fact that only 193 ha of Zone 1A was identified between 2012 and 2016, while 4000 ha was protected through THEZ buffering indicates that the 1A zoning alone was insufficient protection. Indeed, the report acknowledges State forests now support only very few areas that would trigger zone 1 classification.

Despite the positive step of buffering colonies and the recent increase in verified records, there is a wide range of claims and inferences being made that could jeopardise conservation of Leadbeater's Possum.

Table 7.1: Leadbeater's Possum verified records before and after 1 March 2014, excludes areas burnt by 2009 fires and multiple detections covered by single THEZ *[2]*

	Pre 2014 records	Post 2014 records	Total
State forest – GMZ/SMZ	96	340	436
State forest – SPZ	9	4	13
National Park/water catchment	44	2	46
Total	149	346	495

The THEZ review acknowledges **we do not know if the buffer radius of 200m is large enough to be effective**. Two studies were conducted on refugia (small unburnt patches) soon after the 2009 fires which found the minimum area in which Leadbeater's Possum persisted was 10-12ha [18,28]. This would indicate the 12.6 ha buffer is likely to be too small, particularly for roadside sightings where half the buffer may be on the opposite side of a road or other habitat within the buffer is unsuitable. Anchoring of THEZ buffers around sighting locations rather than habitat elements results in the need for larger buffers to ensure sufficient home range is captured (see Figure 7.11).

While the buffering has very likely reduced the number of Leadbeater's Possums killed by logging operations, the THEZ review has focused greatly on the immediate situation, while missing the key long term ecological concerns for the species, namely the population trend continues to decline and there is inadequate protection of existing hollow-bearing trees nor planning for the recruitment of stands of 'new old growth'.

The THEZ buffer review refers frequently to **total population size**. The Executive Summary states that a key knowledge gap is an accurate estimate of total population as well as the proportion of the total population protected by THEZ buffers. The review recommends surveys be continued to allow estimates of total population, while the lack of an accurate estimate of total population is used to explain difficulties in evaluating effectiveness of the buffers. Knowing more about dispersal after fire, the review states, would be useful to help estimates of total population and total population size would assist with better estimates of the impact on the industry. The review suggests the number of records "casts doubt over the accuracy of earlier population estimates and further work is required to provide more robust numbers".

Unfortunately **the data that comes from the survey methods used** (active search, call playback and camera traps) **do not lend themselves to providing population estimates** due to the lack of a stratified randomised design (bias of only looking in areas where Leadbeater's Possum are expected), a lack of repeatability, inconsistent habitat descriptors, and an inconsistent or unknown survey area. The review acknowledges this, saying "*it is not possible to [re]assess population numbers from the recent… new records of Leadbeater's Possums as the targeted nature of the sampling that yielded these new records precludes extrapolation across the whole range*".

Accurate estimates of **total population size** are very difficult to obtain from a distributed, cryptic species like Leadbeater's Possum and survey methods that lack repeatability in time. More importantly, they do not provide time series data needed to quantify population trends that are, in turn, critical for effective conservation and forest management. Long-term data gathered by ANU indicates a significant decline in population and a major collapse in key habitat resources.

Leadbeater's Possum populations have been trending down for over 20 years (Figure 4.1). The **population decline is linked to the reduction in hollow-bearing trees**. While the THEZ buffers will assist in slowing the rate of collapse through protection from logging, HBTs will still be lost through natural decay, climate change and fire (and losses due to logging in areas outside the reserve). Keeping the additional 4,046 ha, or 1.9% of potential habitat of GMZ/SMZ forest in perspective, it is difficult to see how the THEZ buffers could lead to a claim of a 34% reduction in risk of extinction within the reserve system when the majority of factors contributing to the loss of hollow-bearing trees have not been mitigated. It is not clear from the report how the greater population estimate that leads to the 34% figure is reached, particularly when it is based on an unrealistic model that has a scenario of 200 years without fire. The possum population has not increased due to the buffers, but rather the rate of decline may have slowed. To conclude that there are now "sufficient individuals for the species to recover in the future" and that there "remains a residual risk of extinction" and the "establishment of the current THEZs has not achieved complete recovery of the

species" understates the ongoing seriousness of decline. The choice of wording inappropriately suggests that the species is recovering due to the new buffering.

The **importance of hollow-bearing trees** is mentioned several times in the review, but **no clear plan is proposed for the recruitment of additional hollow-bearing trees in the future**. ARI surveyed 287 sites for Leadbeater's Possum. Of these, 148 were found to have the possum present and subsequently a 1ha area around each of the 148 sightings was surveyed for HBTs. The results were sobering. A combined total of only 201 live and dead HBTs were identified. **Live HBTs** were absent from over 60% of sites with an average of 0.7 live HBTs/ha (Figure 7.8). The highest number of live HBTs found on any one site was 8, which is approximately a quarter the density expected on an old growth site. Only 6% of sites had more than 3 live HBTs (the average needed to trigger Zone 1A protection). **Dead HBTs** were more numerous, yet even still, just over half the sites surveyed had no dead HBTs. With a maximum of 11 dead HBTs found on a single site, overall there was an average of 1.7 dead HBTs/ha.

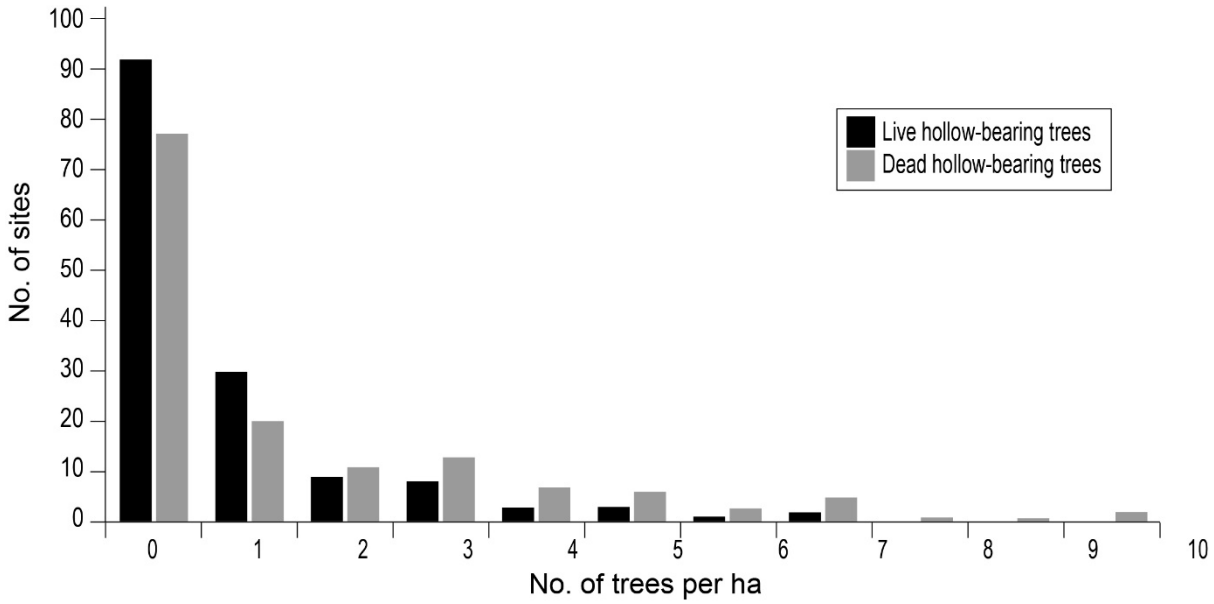


Figure 7.8: Number of live and dead hollow-bearing trees per 1ha around 148 Leadbeater's Possum records (Source: [2])

The very low numbers of HBTs on these 1 ha sites highlights the 'old tree crisis'. Given these were figures from the 148 sites where Leadbeater's Possum has been found, it is likely the remainder of the 287 sites surveyed – which did not have Leadbeater's Possum – had even fewer HBTs, as is common across large areas of ash forest. The lack of HBTs within a hectare of the sighting location also indicates the sightings (and therefore the buffers) are probably not in the middle of the home range, and that Leadbeater's Possum is foraging widely away from denning trees.

On the 148 sites with HBTs surveyed by ARI, the trees were divided into form classes 1-9 (as per ANU HBT descriptions [19]), with 1 being a live tree with intact crown, form 9 being collapsed (Figure 7.9 or Lindenmayer 1993 [19] for written descriptions). For trees younger than what the new 'growth stages of ash' documents have defined as 'mature' (see Chapter 7 above), ARI created a new form class of "0.5" (Figure 7.10). ANU has always included these into form 1 – live tree with its crown intact.

Using known rates of collapse [38], estimates were taken to show the proportion of those HBTs that would collapse by 2030 (Figure 7.10). Given that is little more than a decade away, the decline in abundance of these trees is alarming. If modelled until 2070, when the 1939 trees begin senescing, we can expect nearly all of these current HBTs to have collapsed.

It is the management of hollow-bearing trees that will ultimately decide the future of Leadbeater's Possum, but current buffering is habitat blind. The additional information collected by ARI on HBTs around sightings is informative. It suggests the **THEZ buffers are often not centred on the denning resource**. If broader surveying were done, it would likely show the majority of HBTs used by the colony were within the 200m buffer, although with early radio tracking work showing average movements between den trees of 135m, and movements of up to 600m recorded [43] (in an area of good habitat), it is likely current buffers are inadequate and important habitat will still be lost.

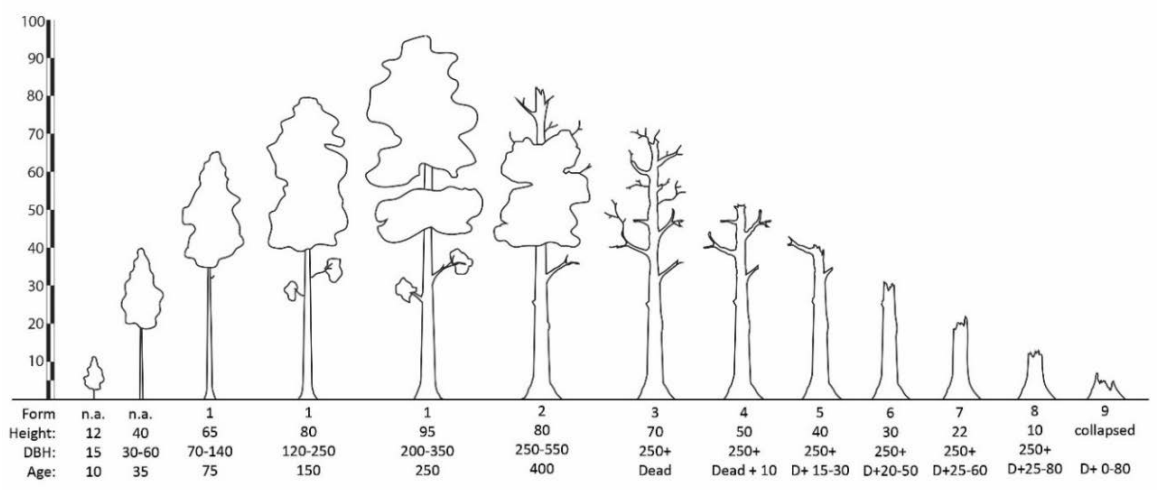


Figure 7.9: Hollow-bearing tree form classes (Source: [33])

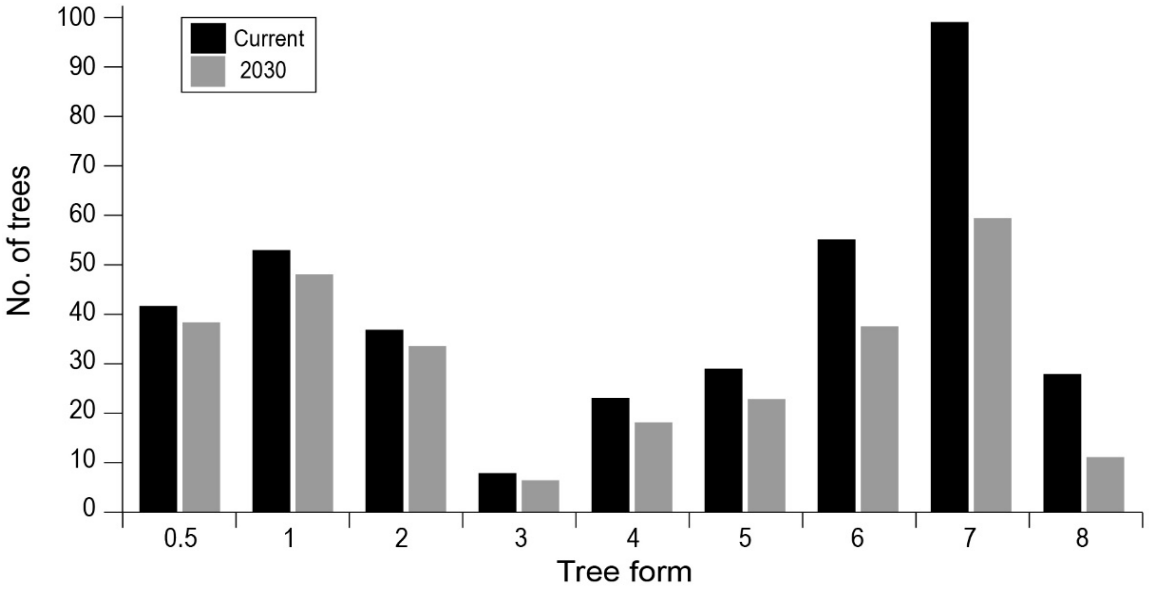


Figure 7.10: Hollow-bearing tree form class (0.5 – 8) in 2016 and predicted numbers in 2030 on 1ha sites around 148 Leadbeater's Possum records. (Source: [2])

An alternative to buffering the sighting locations would be to **base THEZ buffering around HBT resources** (Figure 7.11). The current THEZs are based on sightings rather than HBTs and this has a greater probability of protecting land that is not used by LBP (and could be accessed for harvesting), such as, for example, the opposite side of roads to where detections are made. THEZ buffers centred on the sighting location are also likely to miss important habitat that is used (see Chapter 4 discussion of home range and Figure 7.12). By buffering individual HBTs rather than sighting locations, tree-based THEZs would be a *de facto* updated and simplified version of Zone 1A, rather than just protecting the highest density patches of HBTs. Critically, this would protect the majority of HBTs. It would also help protect other species that require hollow-bearing trees, such as Greater Glider, Yellow-bellied Glider and Sooty Owl.

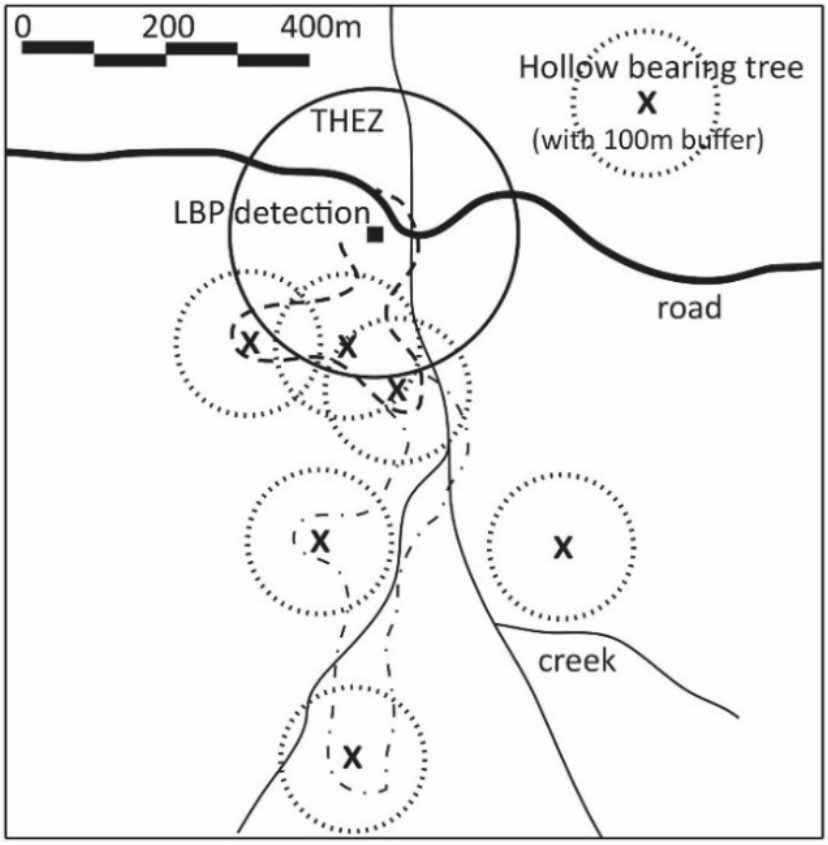


Figure 7.11: Current 200m THEZ (solid circle) centred on sighting (solid square) compared to 100m THEZ based around HBTs (dotted circles). Hypothetical LBP normal foraging range dashed line, extended range thinner dot/dash line based on radio tracking data [43].

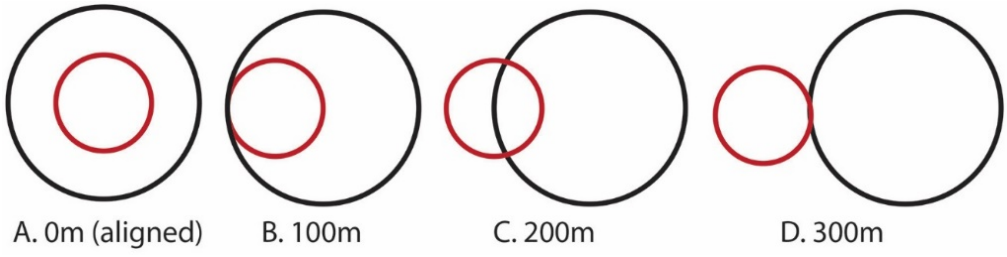


Figure 7.12: Offset between a hypothetical 3 ha home range (red circle) of Leadbeater's Possum and the 12 ha buffer (black circle) when placed where a possum is sighted. (A) If sighting is in the middle of the home range, the buffer encircles the home range. (B) If sighting is 100m from the middle of the home range, the buffer provides no protection from the edge effects on one side. (C) With sightings 200m from the middle of the home range, the buffer covers less than half the home range. (D) If the sighting is 300+m from the centre of the home range the buffer does not cover it at all.

There are many **knowledge gaps** acknowledged within the review, including not knowing the size of Leadbeater's Possum home range, what proportion of the home range each THEZ will cover, total population and how many separate colonies each sighting represents. The most significant knowledge gap however for a review of buffer effectiveness, is: *Are the buffers effective*?

When **evaluating the effectiveness of the THEZ buffers** (Section 2.2 of the review), the appraisal of the buffers is put in terms of how the THEZ "support the recovery of Leadbeater's Possum". The metrics reported are about topics like the proportion of population that is in the buffers or estimating reductions in risk of extinction, **not whether or not the buffers are large enough and are actually working to adequately protect those colonies from logging**. If a colony is sighted, a THEZ applied and the THEZ logged around, does the colony survive? Can young disperse? Does predation increase? What proportion of the home range and den trees used by the colony occur within the buffer? It is these more difficult questions that effective monitoring will need to address before it can be concluded that the buffers have been effective. The answer to these questions will also help with the alternative THEZ design considerations. Other human disturbances such as constructing roads through SPZ buffers should be excluded until the effectiveness of buffers has been determined

ARI is to be complemented on the amount of work is has done to achieve the number of new records and establish the protection measures that arose from this. However, to determine the effectiveness of this system of protection for Leadbeater's Possum and to gain better understand of habitat requirements, well designed long-term monitoring using repeatable field survey methodologies is required. One of the recommendations was landscape scale management. However, the most important and likely most effective action to protect Leadbeater's Possum will be the protection of existing hollow-bearing trees and the recruitment of new cohorts of hollow-bearing trees.

Greater Gliders, Sooty Owl, Yellow-bellied Glider (Photos: E. Beaton, T. Bawden, S. Zozaya)

Chapter 8: Conclusions

Leadbeater's Possum was thought to be extinct, but in 1961 a young scientist, Eric Wilkinson, chanced upon a colony in the forests near Marysville. Since that rediscovery, Leadbeater's Possum has been found to have the most restricted range of any Australian mammal. It is endemic to Victoria with the majority of the population found within the Mountain Ash forests of the Central Highlands.

Unfortunately, the future of the Mountain Ash forests of the Central Highlands, and therefore Leadbeater's Possum itself, is far from assured. Both the possum and the forest ecosystem are Critically Endangered.

The functioning ecology and ecological resilience of the Mountain Ash forests relies on a diversity of species and the existence of trees with hollows. One of the biggest challenges with management of these forests is the time scale at which they persist. Mountain Ash trees can live for more than 400 years and generally do not begin to form hollows before they are 120 years old. Most current hollow-bearing trees germinated prior to Federation and many of the trees that possums and gliders currently inhabit are well over 200 years old. With intermittent high severity fires and the cumulative effect of logging over the last century, the average forest age is now younger than it has ever been, reducing the number of trees likely to grow through to an age where they form suitable hollows.

In addition to decreasing forest age, the effect of logging has also been to simplify the forest structure – that is, the variety of species and the mix of ages of plants in the forest. Mechanical disturbance from logging machinery has caused many plant species to decline.

Looking towards the remainder of this century, it is highly likely the Mountain Ash forests will come under increasing stress from climate change. We have already seen early signs of this through regeneration failure at lower elevations, increased fire frequency and the death of large old trees due to drought. To provide Leadbeater's Possum and other species with the highest chance of survival, the Mountain Ash forests need 'environmental capital' in the form of extensive stands of old growth. Unfortunately, these stocks are at their lowest point, with approximately 1% of the landscape currently supporting old growth forest – in contrast to the historical figure of 30-60%. The next oldest cohort of trees is only 80 years old, regenerated after the 1939 fires. These 80 year old stands need to survive a further 40 years before they start forming hollows. The 1939 cohort has been heavily cut for more than 20 years and now covers just over 30% of the landscape. The extent of the 1939 forests diminishes on a daily basis.

The Mountain Ash forests of the Central Highlands are truly one of the great forests of the world. They contain some of the tallest trees on earth, provide a water resource for 4 million people, are among the most carbon dense forests in the world, and are home to a unique assemblage of plants and animals. However, these forests have never been in as poor health as they are now.

Leadbeater's Possum and its Mountain Ash forest home is one of the most well studied environments in Australia yet despite extensive, high quality science, actions to date have failed to arrest environmental decline. Current decisions on the management of the remaining stands of 1939 regrowth will determine the fate of the Mountain Ash forests for the next 100 years – and whether they are able to support Leadbeater's Possum and other species like the Greater Glider, Yellow-bellied Glider, and the Sooty Owl.

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