Australian National University

New Restoration Forest Management Prescriptions to Conserve Leadbeater's Possum and Rebuild the Cover of Ecologically Mature Forest in the Central Highlands of Victoria

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Version 2: July 2013

Fenner School of Environment and Society

ANU College of
Medicine, Biology and Environment

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CONTENTS

Introduction

Leadbeater's Possum (*Gymnobelideus leadbeateri*) is a nationally and globally endangered species that is endemic to Victoria and one of the State's faunal emblems. Existing strategies to conserve the species are more than 15 years old and new information indicates that they are inadequate as the species is at a very high risk of extinction in the next 20-30 years. Moreover, some of the existing strategies designed for the conservation of Leadbeater's Possum have been significantly watered down (such as those on habitat recognition by the Victorian Government [see http://www.dse.vic.gov.au/__data/assets/pdf_file/0018/156231/APPROVED-DSE-Leadbeaters-Possum-Survey-Standard_21012013.pdf]), leading to areas of suitable habitat being logged and further increasing the species' risk of extinction.

In the 15 years since the last major strategies for the conservation of Leadbeater's Possum were developed (Macfarlane et al. 1998) considerable new research has been conducted. This work has demonstrated:

- There have been significant losses of large old (hollow-bearing) trees which are nesting sites for Leadbeater's Possum (Lindenmayer and Wood 2010; Lindenmayer *et al.* 2012a).

- Old growth stands – which support the highest abundance of hollow-bearing trees (Lindenmayer *et al.* 1991a, 2000) – are a tiny fraction (1/30th-1/60th) of what they were at the time of white settlement. This is the result of a century of logging (including the deliberate past conversion of old growth forest into regrowth stands), 40 years of intensive and extensive clearfelling, and repeated wildfires (Lindenmayer *et al.* 2012a).

- Leadbeater's Possum is absent from sites burned in the 2009 fire and the abundance of the species is significantly depressed on unburned sites where the surrounding landscape has been burned (Lindenmayer *et al.* 2013a).

- Extensive fires in 2009 have damaged almost half of the known habitat of Leadbeater's Possum and the species appears to be on an extinction trajectory. Indeed, populations of Leadbeater's Possum have been lost from extensive areas such as the Lake Mountain region.

The available scientific information clearly indicates that new strategies based on the best available and most up-to-date science are urgently required. This document provides guidelines for a new approach to restoration forest management to better conserve Leadbeater's Possum and rebuild the (ecologically) mature forest estate in the Central Highlands of Victoria. We present six new prescriptions for on-the-ground management that are based on 30 years of detailed ecological research. We also call for an expansion of the National Park in the Central Highlands region. Given these new prescriptions and the expanded reserve, there will be a need for an additional change – a revised estimate of the area that is available for logging, the allocation order and hence the sustained yield. These

prescriptions are intended only for montane ash forests within the known distribution of Leadbeater's Possum and not for elsewhere in Victoria. They are in addition to the Code of Practice for Timber Production (including the maintenance of Special Protection Zones), but the recommended new prescriptions supersede some parts of the Code (e.g. increased width of stream buffers).

Virtually all of the montane ash forest in the Central Highlands of Victoria is managed by State Government agencies and therefore owned by the people of Victoria. Hence, responsibilities for preventing the extinction of wild populations of Leadbeater's Possum lie with the State Government of Victoria. This document is aimed at assisting the Government of Victoria in better managing one of the faunal emblems of the state.

The structure of this document

We present this document as a series of short inter-related sections. Each section comprises three parts. The first summarises background scientific information. The second contains and explains the recommended management action. We then specify the prescription.

Background to this document

Researchers at The Australian National University have worked in the montane ash forests of the Central Highlands of Victoria for 30 years. The work has spanned studies of the habitat requirements and population viability of arboreal marsupials (including Leadbeater's Possum), populations of large old trees, forest dynamics, fire dynamics, logging impacts and numerous other investigations documented in more than 165 peer-reviewed scientific articles and seven books (reviewed in Lindenmayer 2009). The prescriptions in this report are based on that body of research, together with new data from on-going research on the impacts of the 2009 fires on Leadbeater's Possum and its habitat in montane ash forests.

Glossary

Hollow: Any cavity at any height in a tree including holes, fissures and hollow branches (as determined by observation using binoculars; see Lindenmayer et al., 1993b) and which can be occupied by any species of arboreal marsupial.

Hollow-bearing tree: A hollow-bearing tree is defined as any tree of any height, whether it is living or dead, greater than 80 cm in diameter at breast height and containing one or more hollows (*sensu* Lindenmayer et al. 1997; see Lindenmayer et al. 1993b).

Old growth forest: Old growth forest is defined as a patch of forest exceeding 3 ha in size where the dominant overstorey trees are 120 years or older.

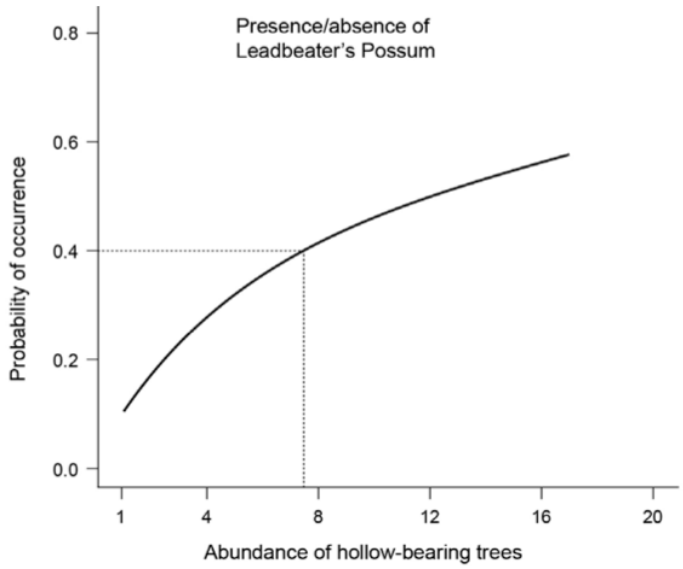
Multi-aged forest: A multi-aged forest is a stand supporting trees from two or more distinct age cohorts (see Lindenmayer and McCarthy 2002; Mackey et al. 2002).

1. A new zoning system for Leadbeater's Possum

Background scientific information:

The habitat requirements of Leadbeater's Possum have been the topic of a series of detailed studies over the past 25 years (Lindenmayer et al. 1991b, 1994, 2011b). That work has shown repeatedly that the probability of occurrence of the species at a site is significantly correlated with the abundance of hollow-bearing trees on a site (Lindenmayer et al. 1991b, 1994, 2011b, 2013a). That is, the more hollow-bearing trees that occur on a site, the higher the probability that Leadbeater's Possum will occur on that site. Current prescriptions for Zone 1 habitat for Leadbeater's Possum divide the zoning into habitat containing live trees (Zone 1A) or live and dead trees (Zone 1B). However, the original prescriptions were based on research from 1990-1991 at a time when both Leadbeater's Possum and hollow bearing trees were considerably more numerous than today. Long-term research has consistently shown the importance of both living and dead trees as nest sites for Leadbeater's Possum. Indeed, the vast majority of trees occupied by Leadbeater's Possum are dead hollow-bearing trees (Lindenmayer et al. 1991c), which have poor levels of protection under current prescriptions. Nevertheless, living hollow-bearing trees are also important because they will remain standing much longer than highly decayed trees (Lindenmayer et al. 2012a) (including persisting after future fire) and will be the next cohort of dead hollow-bearing trees in the future. For this reason, the current zoning system for Leadbeater's Possum must be revised to include living and dead trees and a reduced detection rate from the original 50% probability of detection on a site (as per the original 1A prescriptions) to a more conservative figure of 40%, in accordance with the increasing rarity of the possum. As shown in Figure 1, this means 8 hollow-bearing trees (living trees and/or dead trees) per 3 ha and irrespective of the density of wattle (*Acacia* spp.) trees in a stand.

Figure 1: *Relationships between the abundance of (living and dead) hollow-bearing trees per 3 ha and the probability of occurrence of Leadbeater's Possum*



Based on the results of ongoing and recently updated work on the habitat requirements of Leadbeater's Possum, we argue there is a need to redefine Zone 1 habitat for the species. This redefinition demands that both living and dead trees are considered in the definition of Zone 1 forest.

To better protect identified habitat areas a 100 m wide buffer should be established adjacent to the boundary of a given area of Zone 1 habitat to: **(1)** protect hollow-bearing trees from fires lit to regenerate nearby logged areas, **(2)** protect hollow-bearing trees from wind damage, and **(3)** protect colonies of Leadbeater's Possum because the species is sensitive to disturbance of the surrounding landscape (Lindenmayer et al. 1993a, 2013a). Areas of Zone 1 habitat should be recognised as Special Protection Zones and this status means that it is possible to plan for the location of loggable areas. To avoid areas of Zone 1 forest being mistakenly logged, careful aerial and on-ground assessments of all areas proposed for logging in the montane ash forests of the Central Highlands of Victoria must be completed prior to harvesting taking place. The location of areas of Zone 1 forest and the adjacent buffers must be mapped and the subsequent spatial data lodged on the Government Geographic Information System to ensure they are clearly delineated as logging exclusions.

Prescription 1:

1.1.1 Zone 1 habitat for Leadbeater's Possum is any area of forest of 3 hectares or more that supports eight or more living or dead hollow-bearing trees per 3 hectares.

1.1.2 Zone 1 habitat will be protected by a 100 m wide buffer of unlogged forest.

1.1.3 Logging is not permitted in Zone 1 habitat or in associated buffers.

1.2 Careful aerial and on-ground assessments of all areas proposed for logging must be completed prior to commencement of harvesting.

1.3 The location of areas of Zone 1 forest and the adjacent buffers will be mapped and the subsequent spatial data lodged on the Government Geographic Information System.

2. Strengthened protection of locations known to support Leadbeater's Possum

Background scientific information:

A key part of the conservation of any organism is to protect individuals where they are known to occur. Recent (currently unpublished) analyses of time series data on arboreal marsupials gathered from 1997 to 2012 indicates that the probability of occurrence of Leadbeater's Possum on a site is significantly influenced by the prior occurrence of the species at a site. This indicates that animals have long-term site affinity – a result consistent

with earlier work on the long-term occupancy of hollow-bearing trees by the species (Lindenmayer 1991).

Recommended Management Action:

Long-term site affinity by Leadbeater's Possum suggests that it is important to protect sites where the species has been recorded in the past 15 years. The protection of these known locations is particularly important given the crucial role of animals from these remaining populations in assisting the recolonisation of previously burned areas. Given the estimated home range of Leadbeater's Possum, coupled with colonial social organisation of the species (Smith 1984), we suggest that a logging exclusion area (i.e. an area excluding both clearfelling and thinning) be established around the known locations of the species. A 1 km buffer is proposed, based on sensitivity of the species to landscape-level disturbance (Lindenmayer et al. 1993a, 2013a).

All distribution records of Leadbeater's Possum and associated buffers must be mapped and the subsequent spatial data lodged on the Government Geographic Information System to ensure they are clearly identified and delineated as areas from which logging is excluded.

If Leadbeater's Possum has not been detected at a location within the previous 15 years, then that location would revert to Zone 1 habitat for subsequent protection, provided that meets the requirements of Prescription 1.

Prescription 2:

2.1 All locations where Leadbeater's Possum has been recorded present in the past 15 years will be protected by a 1 km buffer from which logging (both clearfell and thinnings) is excluded.

2.2 All distribution records of Leadbeater's Possum and associated buffers will be mapped and lodged on the Government Geographic Information System. No logging should proceed in a given forest block until the collation of all location records of Leadbeater's Possum has been completed. The Government of Victoria should seek records from all reputable sources such as Field Naturalist Groups, universities and other organisations responsible for gathering high-quality field surveys in montane ash forests.

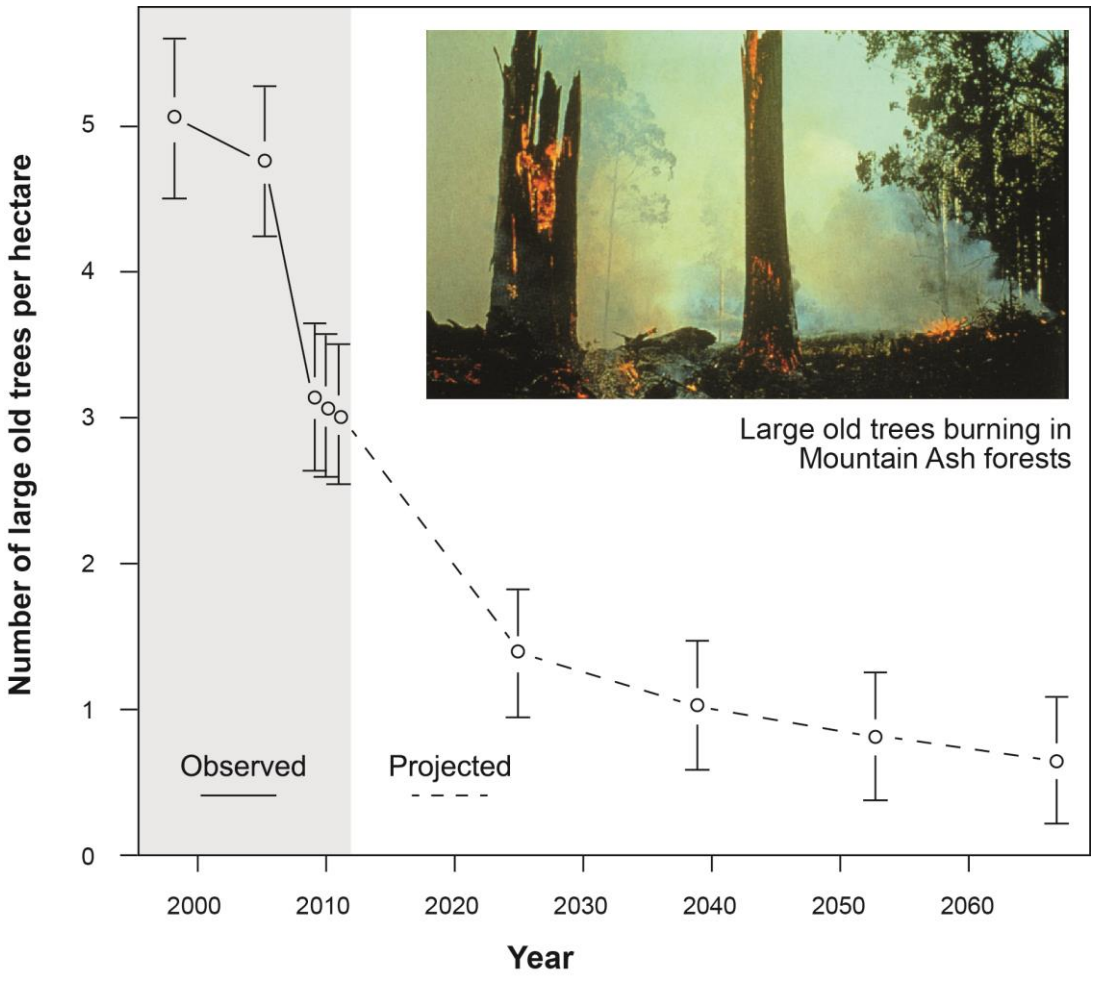
3. Enhanced protection of all living and dead hollow-bearing trees

Background scientific information:

Large old trees are a critical part of the habitat requirements of Leadbeater's Possum and are extremely difficult to replace because of the prolonged time it takes for them to develop (Lindenmayer et al. 2012b). Repeated field studies and associated statistical analyses have clearly indicated that the presence and abundance of Leadbeater's Possum is significantly

related to the abundance of hollow-bearing trees on a site (Lindenmayer et al. 1991b, 2011b) (see Prescription #1 above). The abundance of these trees is declining rapidly as a result of fire, natural attrition, and logging operations (Lindenmayer et al. 2012a) (Figure 2). Hollow-bearing trees have a high risk of being incinerated by high-intensity fires lit to regenerate logged stands (Lindenmayer et al. 1990). These trees suffer from accelerated rates of collapse when adjacent areas of forest are logged (Lindenmayer et al. 1997, and unpublished data). Using long-term datasets on tree condition, we project a striking and catastrophic collapse in the number of large old trees in Mountain Ash forests, from an average of 5.1 trees per hectare in 1998 to just 0.6 trees per hectare by 2067 (Lindenmayer et al. 2012a). This could cause the local extinction of many species of cavity-dependent vertebrates and the global extinction of Leadbeater's Possum. Notably, these projections do not include the rapidly accelerated losses of hollow-bearing trees that occur on logged sites (Lindenmayer et al. 1990) and within unlogged areas adjacent to logged sites (Lindenmayer et al. 1997).

Figure 2: *Projected changes in the abundance of large old hollow-bearing trees in the Mountain Ash forests of the Central Highlands of Victoria. Projections are based on data in Lindenmayer et al. (2012a). Projections have been made to 2067 as this is when stands dominated by regrowth dating from the 1939 wildfires (and which is currently the most widespread age cohort) first begin to develop cavities.*



Recommended Management Action:

The fundamental ecological importance of large old hollow-bearing trees for Leadbeater's Possum (and a wide range of other hollow-dependent vertebrates (Lindenmayer 2009)) in montane ash forests means that new and significantly improved efforts are required to better protect these trees. This must encompass the enhanced protection of all existing hollow-bearing trees (living and dead). We further recommend that each existing living and dead hollow-bearing tree be buffered by a surrounding area of unlogged forest. The need for buffering is based on: **(1)** information on the overall susceptibility of large, old trees to collapse in montane ash forests (Lindenmayer et al. 2012a), **(2)** accelerated rates of destruction and/or collapse of hollow-bearing trees on logged and regenerated sites (Lindenmayer et al. 1990, 2012a), and **(3)** the risks of collapse of trees in unlogged forests adjacent to logged coupes (Lindenmayer et al. 1997).

The buffering distance of 100 m is based on three key criteria: **(1)** empirical data on the accelerated rates of destruction and/or collapse of hollow-bearing trees on logged and regenerated sites (Lindenmayer et al. 1990, 2012a), **(2)** the risks of collapse of trees in unlogged forest adjacent to logged areas (Lindenmayer et al. 1997), and **(3)** the protection of potentially suitable foraging habitat and movement patterns around nesting sites in unlogged forest around hollow-bearing trees (Lindenmayer and Meggs 1996). The location of a given tree would act as the centroid of the buffer. The locations of buffers need to be mapped and lodged on the Government Geographic Information System to ensure they are clearly delineated as logging exclusions.

Prescription 3:

3.1 Each hollow-bearing tree (whether living or dead) will be surrounded by a buffer of unlogged forest measuring 100 m in radius.

3.2 The locations of buffers to protect living and dead hollow-bearing trees will be mapped and the subsequent spatial data lodged on the Government Geographic Information System.

3.3. All trees 100 or more years old should be protected and surrounded by a buffer of unlogged forest measuring 100 m in radius.

4. Protect all areas of existing old growth and expand the cover of old growth to 30% of all Leadbeater's Possum Management Units

Background scientific information:

Old growth montane ash forest is where the highest numbers of hollow-bearing trees occur (Lindenmayer et al. 1991a; 2000). Such areas are therefore critical places for providing these key structural attributes of stands that are an essential part of the habitat requirements of Leadbeater's Possum. However, as a result of deliberate past removal, fire, logging and salvage logging, old growth Mountain Ash forest now comprises just 1.15% of

the Mountain Ash forest estate in the Central Highlands of Victoria (Lindenmayer et al. 2012a). This compares with an estimated 30-60% of the Mountain Ash forest estate being multi-aged or old growth prior to European settlement (Lindenmayer et al. 2011a). Moreover, most of the old growth forest estate is sparsely distributed as small and highly fragmented patches spread across the landscape. The paucity of old growth Mountain Ash forest is a result of a prolonged history of extensive and intensive logging operations, recurrent wildfires, and extensive post-fire salvage logging (Lindenmayer et al. 2012a). The rarity of old growth Mountain Ash forest is a major conservation problem and significant management issue in the Central Highlands of Victoria. Although all existing patches of old growth montane ash forest are currently protected in the Central Highlands of Victoria, there is an urgent need to ensure that the old growth estate is significantly expanded in the future.

Recommended Management Action:

We argue that a new approach to "restoration forestry" is needed that aims to ensure that at any given time, 30% of the area of each Leadbeater's Possum Management Unit will be old growth forest. The 30% target corresponds to the minimum area of old growth/multi-aged forest that reconstruction analyses by McCarthy and Lindenmayer (1998) found likely to have characterised Mountain Ash forests prior to European settlement.

To reach the 30% old growth target for each Leadbeater's Possum Management Unit, we recommend that 50% of the currently oldest forest be designated for protection with the explicit aim of growing it through to an old growth stage. We specify 50% because of the risk of wildfire that will affect some of the areas set aside during the next 100 years as well as the current paucity of old growth and the corresponding need to recruit areas of old growth as quickly as possible. The 50% of each Leadbeater's Possum Management Unit targeted for old growth development would be excluded from logging to protect the next nearest age cohorts of forest that have the shortest period to mature before they become old growth. The age cohorts to be protected would be any current old growth as well as stands dating from the early 1900s, 1926 and 1932, but also extensive stands of 1939-aged montane ash forest. The location of the oldest areas of forest being protected will need to be re-assessed each time there is a fire. This would aim to ensure that protected stands were focused around the oldest, unburned "green areas" consistent with the explicit objective under this policy of reaching an area target of 30% of each Leadbeater's Possum Management Unit. If the 50% logging exclusion strategy over-achieves the 30% old growth forest target in a given Leadbeater's Possum Management Unit, then the level of exclusion may be relaxed following a detailed assessment of the status of the forest estate.

The Recovery Plan for Leadbeater's Possum lists the Leadbeater's Possum Management Units (DNRE 1997). We recommend that the old growth estate of each Leadbeater's Possum Management Unit must be significantly expanded so that it will cover a minimum of 30% of the area of that management unit. The oldest existing areas of forest should be targeted for protection from logging to reduce the time required to achieve the 30% old growth target. The location of these protected areas to be grown through to an old growth stage within each Leadbeater's Possum Management Unit must be mapped and lodged on

the Government Geographic Information System so that they are clearly delineated as logging exclusion areas. We strongly recommend that areas targeted for recruitment to become old growth should be located on comparatively flat topography and on sheltered aspects that are characterised by low levels of incoming radiation. This is because previous studies have indicated such places have reduced susceptibility to high frequency and high severity wildfire (Lindenmayer et al. 1999; Mackey et al. 2002).

The location of protected areas used to rebuild the coverage of the old growth estate within each Leadbeater's Possum Management Unit would need to be re-assessed after a major fire event or in the event of escaped regeneration burns or fuel reduction burns affecting the reserve.

Prescription 4:

4.1.1 The old growth estate of each Leadbeater's Possum Management Unit will be expanded to cover a minimum of 30% of the area of that management unit.

4.1.2 To reach the 30% old growth target for each Leadbeater's Possum Management Unit, 50% of the currently oldest forest will be designated for protection with the explicit aim of growing it through to an old growth stage.

4.1.3 The oldest existing areas of forest will be targeted for protection from logging.

4.1.4 Areas selected for recruitment to become old growth will be located on comparatively flat topography and on sheltered aspects that are characterised by low levels of incoming radiation.

4.1.4 If the 50% logging exclusion strategy over-achieves the 30% old growth forest target in a given Leadbeater's Possum Management Unit, then the level of exclusion may be relaxed following a detailed assessment of the status of the forest estate.

4.2 The location of these protected areas to be grown through to an old growth stage within each Leadbeater's Possum Management Unit will be mapped and the subsequent data lodged on the Government Geographic Information System.

4.3.1 Should a fire affect the reserve system, the location of protected areas used to rebuild the coverage of the old growth estate within each Leadbeater's Possum Management Unit will be re-assessed.

4.3.2 In the event of a fire that affects the old growth reserve, the areas protected will be amended to encompass the oldest areas of unburned forest.

4.3.3 Any area of old growth forest that is burned will not be salvage logged.

4.3.4 Subject to the above prescriptions protecting large old trees, an area not assessed as Zone 1 Leadbeater's Possum habitat may come back into production forestry zoning (GMZ).

5. Expanded riparian buffers

Background scientific information:

The highest abundance of hollow-bearing trees occurs in gullies (Lindenmayer et al. 1991a). As outlined above, hollow-bearing trees are a critical component of the habitat of Leadbeater's Possum (Lindenmayer et al. 1991b, 1994, 2011b), but they are also at high risk of rapid decline and need careful and targeted protection (Lindenmayer et al. 2012a, 2013b) (see Prescription #3 above). Hollow-bearing trees are at risk of accelerated rates of collapse in narrow strips such as those between adjacent logging coupes (Lindenmayer et al. 1997). In addition, very narrow strips of retained forest are often of inappropriate spatial dimensions to provide suitable habitat for Leadbeater's Possum, most probably as a result of the species having difficulty in efficiently harvesting food and/or maintaining social cohesion in the matriarchal colony structure (Lindenmayer et al. 1993a).

Recommended Management Action:

We argue there is a need to increase the width of riparian (streamside) reserves within wood production forests to: **(1)** better protect existing hollow-bearing trees, **(2)** increase the chances that existing regrowth trees can grow through to ecological maturity and become hollow-bearing trees, and **(3)** increase the chances that areas of retained forest will provide suitable habitat for Leadbeater's Possum (Lindenmayer et al. 1993a).

Based on data on the relationships between the width of retained forest and rates of attrition of hollow-bearing trees (see Lindenmayer et al. 1997), together with the urgent need to recruit new cohorts of hollow-bearing trees in montane ash forests, we recommend that streamside buffers be widened to be a minimum of 100 m either side of a permanent stream and a temporary stream (as defined in the Code of Forest Practice for Timber Production) (Department of Sustainability and Environment 2007). Note, these are buffers where extraction of trees is prohibited, they are not filter strips. The location of the expanded network of streamside buffers must be mapped and lodged on the Government Geographic Information System to ensure they are clearly delineated as logging exclusions.

Prescription 5:

5.1.1 Streamside buffers will be widened to a minimum of 100 m either side of a permanent stream, pool or wetland or temporary stream.

5.1.2 These buffers may form part of the 30% old growth reserve (see Prescription #4 above).

5.2 The location of the expanded network of streamside buffers will be mapped and the subsequent spatial data lodged on the Government Geographic Information System.

6. Replacement of clearfell logging by modern retention harvesting

Background scientific information:

The predominant form of logging in montane ash forests is clearfelling. An array of studies has highlighted the significant negative long-term environmental impacts of clearfelling at both the stand and landscape scales (reviewed in Lindenmayer 1994, 2009). Given that all overstorey trees are cut down on clearfelled sites and that the hollow-bearing trees used by Leadbeater's Possum are typically 120-190+ years old, areas that are logged will take almost two centuries before they will develop suitable habitat for the species.

Recommended Management Action:

The multi-party Forestry Roundtable Meeting held at Marysville in September 2002 recommended a transition away from widespread clearfelling to more environmentally sensitive retention harvesting in Victorian montane ash forests (Lindenmayer and Franklin 2003). Experimental work undertaken by The Australian National University in collaboration with VicForests and the Department of Sustainability and Environment has clearly shown that variable retention harvesting is logistically feasible in Victorian montane ash forests (Lindenmayer et al. 2010). A report provided under a contract to the Victorian Department of Primary Industries in 2007 suggested the benefits of adopting the variable retention harvest system in Victorian montane ash forests (Lindenmayer 2007). Variable retention harvest systems are now widely employed in Tasmania in ash-type forests but Victoria has lagged behind and the method has not been operationalised in this State.

We recommend that Victorian forest management agencies completely dispense with clearfelling by the end of 2013 and thereafter any logging of coupes should be via the use of retention harvest methods. The methods recommended are those of 'aggregated retention' which Tasmania has found provides the most optimal results. Aggregated retention aims for adequate eucalypt regeneration with enhanced biodiversity and aesthetic outcomes by retaining patches of undisturbed forest for a full rotation (Baker and Read 2011). The retention practice involves the retention of 30% of the coupe area in patches/aggregates/ islands, with the majority of the harvested area within one tree height (60m) of retained forest, a low intensity burn and natural seedfall. This provides greater habitat retention across the landscape and close proximity of late-successional species for recolonisation back into disturbed areas.

Coupes may still be a maximum 40 ha net area, but a smaller coupe size is recommended to facilitate management of the regeneration burn. Low intensity burns will be needed and minimal artificial seeding is predicted to be required due to seed falling from surrounding trees. Mapping of the locations of islands/aggregates within variable retention coupes will

indicate their status within otherwise cut areas. This will lead to a “whole-of-rotation” approach to planning harvest units. These retained areas, if of sufficient size (and still alive after the regeneration burn), can be included in the 50% old growth reserve if forest age is adequate.

Prescription 6:

6.1.1 Variable retention harvesting methods will replace clearfelling in Victorian montane ash forests from 1st January 2014.

6.1.2 Clearfelling methods will not be employed after 31st December 2013.

6.2.1 A coupe will not exceed a maximum net harvested area of 40 hectares.

6.2.2 The majority of harvested area will be within one tree height (60 m) of retained forest.

6.3.1 A minimum of 30% of the coupe area will be retained as aggregates.

6.3.2 Retained areas may be in the form of islands (minimum 1 ha in size) or as ‘peninsulas’/islands anchored to the unharvested edge of the coupe.

6.3.3 Retained areas of sufficient size (and still present after the regeneration burn), can be included in the 50% old growth reserve if forest age is adequate.

6.3.4 Islands/aggregates within variable retention coupes will be permanently reserved and their locations mapped and the subsequent spatial data lodged on the Government Geographic Information System.

6.4.1 Regeneration burns will be of low intensity.

6.4.2 During regeneration burns, all living and dead hollow-bearing trees will be protected with a 100 m buffer as outlined in Prescription #3 above.

7. Revise estimates of the area available for logging, the allocation order, and sustained timber and pulpwood yield

Background scientific information:

The new scientifically-based prescriptions that we have proposed, coupled with the need for an expanded National Park, will lead to a reduction in the amount of resource available for industrial logging in the montane ash forests of the Central Highlands of Victoria. Moreover, the current regime of “logging-as-usual” under a policy of “no net loss to the pulpwood and timber industries” is not ecologically sustainable, even in the short term, given: **(1)** the large area of forest burned in the 2009 fires, **(2)** the current (old-growth depauperate) state of montane ash forests ecosystems, and **(3)** the precarious state of Leadbeater’s Possum.

Therefore, sustained yield will need to be reset once changes to prescriptions have been made (and not vice-versa).

Policy recommendation:

The preceding prescriptions for protecting Leadbeater's Possum will underpin a substantial reform of logging operations in the Central Highlands of Victoria. There will need to be revised estimates of the area that is available for logging, revised estimates of the allocation order and hence revised estimates of the sustained yield. These revisions will be needed once the prescriptions have been implemented (and not vice versa). Exit packages for timber workers and contractors are likely to be needed as a result of these reforms to ensure that the forest industry can be restructured in an ecologically sustainable but socially-just way. However, additional jobs may be found in implementing the prescriptions we have recommended through appropriately increased levels of forest assessment, mapping and habitat assessment.

Implications for the Forest Industry in the Central Highlands of Victoria

The prescriptions outlined above are needed to increase the level of protection of habitat for Leadbeater's Possum, to ensure better protection of large old hollow-bearing trees, to establish a commitment to increasing the old-growth forest estate, and to expand the riparian (streamside) reserve system. These changes are a necessary part of restorative management to increase the chances of persistence of populations of Leadbeater's Possum and recover the old growth forest estate.

Further work

The altered prescriptions we have outlined will demand careful mapping of logging exclusion areas throughout montane ash forests to delineate: **(1)** areas of Zone 1 forest and the associated buffers for Zone 1 forest, **(2)** individual living and dead hollow-bearing trees and the 100 m protection buffers for hollow-bearing trees, **(3)** logging exclusion areas to rebuild the old growth forest estate, and **(4)** the network of widened streamside reserves. This mapping must be accompanied by rigorous on-the-ground surveys to properly assess all proposed logging areas.

Two other key areas of work are required. First, there is an urgent need to commence research on how to accelerate the rate of development of cavities in trees. This new work is needed because traditional methods of providing artificial cavities through nest boxes have been unsuccessful in the Central Highlands of Victoria (Lindenmayer et al. 2003, 2009).

The second area of further work is the continuation of existing long-term work that has been underway in the Central Highlands of Victoria for the past 30 years. Long-term monitoring is critical for underpinning informed forest and biodiversity conservation and management – as highlighted by the use of detailed ecological science in this report to make recommendations for upgraded prescriptions for the conservation of Leadbeater's Possum.

An increase the formal reserve system through an expanded National Park

The bulk of the preceding commentary has focused on forest restoration strategies within areas broadly designated for pulp and timber production. We argue that, in addition to these strengthened restoration strategies, there is a need to expand the formal reserve system in Mountain Ash forests, especially as Leadbeater's Possum is vulnerable to extinction in the advent of future wildfires. Large ecological reserves are at the core of any credible approach for forest biodiversity conservation (Lindenmayer and Franklin 2002). In particular, it is critical that a given protected area covers sufficient forest to be larger than the size of major disturbance events such as wildfires (Baker 1995). Notably, work by Todd et al. (unpublished data) has indicated that the current formal reserve is too small and fragmented to support viable populations of Leadbeater's Possum if additional fires occur in the next 100 years. An expanded large ecological reserve from which logging is excluded is important for other reasons. A key one is that it will be an area where there are a reduced number of stressors and, in turn, where there is a greater chance of natural fire regimes and the processes of recruitment of large old trees being restored. A further key role of an expanded National Park will be to connect key areas of current and future suitable habitat for Leadbeater's Possum and, through such enhanced connectivity, promote the dispersal of the species throughout forest landscapes, including those regenerating after wildfire.

PRESCRIPTIONS

Prescription 1 – Zone 1 Habitat for Leadbeater's Possum

1.1.1 Zone 1 habitat for Leadbeater's Possum is any area of forest of 3 hectares or more that supports eight or more living or dead hollow-bearing trees per 3 hectares.

1.1.2 Zone 1 habitat will be protected by a 100 m wide buffer of unlogged forest.

1.1.3 Logging is not permitted in Zone 1 habitat or in associated buffers.

1.2 Careful aerial and on-ground assessments of all areas proposed for logging must be completed prior to commencement of harvesting.

1.3 The location of areas of Zone 1 forest and the adjacent buffers will be mapped and the subsequent spatial data lodged on the Government Geographic Information System.

Prescription 2 – Protection of recorded locations

2.1 All locations where Leadbeater's Possum has been recorded present in the past 15 years will be protected by a 1 km buffer from which logging (both clearfell and thinnings) is excluded.

2.2 All distribution records of Leadbeater's Possum and associated buffers will be mapped and lodged on the Government Geographic Information System. No logging should proceed in a given forest block until the collation of all location records of Leadbeater's Possum has been completed. The Government of Victoria should seek records from all reputable sources such as Field Naturalist Groups, universities and other organisations responsible for gathering high-quality field surveys in montane ash forests.

Prescription 3 – Protection of Hollow-bearing Trees

3.1 Each hollow-bearing tree (whether living or dead) will be surrounded by a buffer of unlogged forest measuring 100 m in radius.

3.2 The locations of buffers to protect living and dead hollow-bearing trees will be mapped and the subsequent spatial data lodged on the Government Geographic Information System.

3.3 All trees 100 or more years old should be protected and surrounded by a buffer of unlogged forest measuring 100 m in radius.

Prescription 4 – Protection of Old Growth within the Reserve System

4.1.1 The old growth estate of each Leadbeater's Possum Management Unit will be expanded to cover a minimum of 30% of the area of that management unit.

4.1.2 To reach the 30% old growth target for each Leadbeater's Possum Management Unit, 50% of the currently oldest forest will be designated for protection with the explicit aim of growing it through to an old growth stage.

4.1.3 The oldest existing areas of forest will be targeted for protection from logging.

4.1.4 Areas selected for recruitment to become old growth will be located on comparatively flat topography and on sheltered aspects that are characterised by low levels of incoming radiation.

4.1.4 If the 50% logging exclusion strategy over-achieves the 30% old growth forest target in a given Leadbeater's Possum Management Unit, then the level of exclusion may be relaxed following a detailed assessment of the status of the forest estate.

4.2 The location of these protected areas to be grown through to an old growth stage within each Leadbeater's Possum Management Unit will be mapped and the subsequent data lodged on the Government Geographic Information System.

4.3.1 Should a fire event affect the reserve system, the location of protected areas used to rebuild the coverage of the old growth estate within each Leadbeater's Possum Management Unit will be re-assessed.

4.3.2 In the event of a fire that affects the old growth reserve, the areas protected will be amended to encompass the oldest areas of unburned forest.

4.3.3 Any area of old growth forest that is burned will not be salvage logged.

4.3.4 Subject to the above prescriptions protecting large old trees, an area not assessed as Zone 1 Leadbeater's Possum habitat may come back into production forestry zoning (GMZ).

Prescription 5 – Protection of Streamside Buffers

5.1.1 Streamside buffers will be widened to a minimum of 100 m either side of a stream, whether permanent or temporary/seasonal.

5.1.2 These buffers may form part of the 50% old growth reserve (see Prescription #4 above).

5.2 The location of the expanded network of streamside buffers will be mapped and the subsequent spatial data lodged on the Government Geographic Information System.

Prescription 6 – Silvicultural System and Coupe Design

6.1.1 Variable retention harvesting methods will replace clearfelling in Victorian montane ash forests from 1st January 2014.

6.1.2 Clearfelling methods will not be employed after 31st December 2013.

6.2.1 A coupe will not exceed a maximum net harvested area of 40 hectares.

6.2.2 The majority of harvested area will be within one tree height (60 m) of retained forest.

6.3.1 A minimum of 30% of the coupe area will be retained as aggregates.

6.3.2 Retained areas may be in the form of islands (minimum 1 ha in size) or as ‘peninsulas’/islands anchored to the unharvested edge of the coupe.

6.3.3 Retained areas of sufficient size (and still present after the regeneration burn), can be included in the 50% old growth reserve if forest age is adequate.

6.3.4 Islands/aggregates within variable retention coupes will be permanently reserved and their locations mapped and the subsequent spatial data lodged on the Government Geographic Information System.

6.4.1 Regeneration burns will be of low intensity and low severity.

6.4.2 During regeneration burns, all living and dead hollow-bearing trees will be protected with a 100 m buffer as outlined in Prescription #3 above.

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