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Failing to conserve Leadbeater's Possum and its Mountain Ash forest habitat

David Blair[1]

David Lindenmayer[1]

Lachlan McBurney[1]

[1]Fenner School of Environment and Society, The Australian National University, Canberra, ACT 2601

Corresponding author: david.blair@anu.edu.au

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Running Head: Undermining Leadbeater's Possum conservation

Abstract

The conservation of the Critically Endangered Leadbeater's Possum *Gymnobelideus leadbeateri* in Victoria's Mountain Ash *Eucalyptus regnans* forests is one of the most controversial native mammal conservation issues in Australia. Much of the controversy results from long-running conflicts between the demands of the native forest logging industry and associated impacts on Leadbeater's Possum and its Mountain Ash forest habitat. Here we argue that despite a legislative obligation to protect Leadbeater's Possum and some limited recent improvements in management, conservation efforts for the species have gone backwards over the past decade. The key problems we identify include that the Victorian Government has: (1) maintained levels of wood production that are too high given the amount of the forest estate that was burned in 2009, (2) failed to substitute clearfell logging practices with more ecologically-sensitive Variable Retention Harvesting Systems, (3) ignored the science (including by its own researchers) on the need for a large protected area for Leadbeater's Possum, (4) altered key definitions such as those for mature trees and old growth that have substantially weakened the ability to protect the species, and (5) overlooked the array of forest values beyond timber production (such as water and tourism) and which make a greater contribution to the economy. Our analyses suggest that populations of Leadbeater's Possum are undergoing a substantial decline, as are other hollow-dependent species such as the Greater Glider *Petauroides volans*. Far more concerted efforts are needed to conserve not only Leadbeater's Possum but also the Mountain Ash forests in which it presently occurs.

Introduction

Australia leads the world in mammal extinctions with approximately 10% of the nation's native mammal species now extinct over the past 220 years (Woinarski *et al.* 2015) with additional species continuing to be lost (Woinarski *et al.* 2017). Cross-continent comparisons are telling, with the number of species lost in Australia 30 times greater than continental USA which is of a similar area (Woinarski *et al.* 2015). One of Australia's most controversial mammal species of conservation concern is the Critically Endangered Leadbeater's Possum *Gymnobelideus leadbeateri*. Much of the controversy over its conservation is underpinned by the fact that a substantial part of its distribution occurs in highly productive Mountain Ash *Eucalyptus regnans* forests in the Central Highlands of Victoria (Lindenmayer *et al.* 2015b), which are also an important source of pulp and timber for the native forest timber industry (Keith *et al.* 2017a).

Concerns about the conservation of Leadbeater's Possum date back over 40 years (e.g. Warneke 1968; Lindenmayer 1996; Lindenmayer *et al.* 2015c). Extensive scientific information is available to guide the most effective management decisions to conserve Leadbeater's Possum. However, to date, many of these decisions have not been made. While some improvements in the protection of the species have recently occurred, here we argue that overall conservation efforts for this species have gone backwards in the past decade. In this paper, we briefly outline a series of decisions, policies and management actions that have undermined conservation actions for Leadbeater's Possum and the Mountain Ash habitat on which the species depends.

Examples of poor management of, and policies for, Leadbeater's Possum and its Mountain Ash habitat

Failure to respond to the need for reduced timber yields as a consequence of major natural disturbances

The Mountain Ash forest estate in the Central Highlands of Victoria covers approximately 157 000 ha with an estimated 78 300 ha, or almost half, of this estate burned in the 2009 Black Saturday wildfires. These fires burned more than 40% of potentially suitable habitat for Leadbeater's Possum, with animals typically now absent from the vast majority of places where they formerly occurred (Lindenmayer *et al.* 2013). Remaining areas of unburned forest have therefore become critical for the continued persistence of Leadbeater's Possum. Despite this, and the loss of so much forest after the 2009 wildfires, there was no appetite on the part of the Victorian Government to reduce the sustained yield of timber and pulpwood from Mountain Ash forests. A year after the fires, senior government officials were provided with two major scientific analyses of the rapid decline over the decade prior to the fires of the hollow-bearing tree resource. The scale of impact from the fires was known and further decline was predicted. Despite this, the stated perspective was there would be "no net loss in timber supply to the forest industry". With the same volumes now coming from half the forest area, this resulted in concentrated harvesting in the remaining unburnt forest, thereby increasing the intensity of logging in important remaining habitat. The no-net loss approach essentially locked in over-cutting and left only limited 'environmental margin' to enhance the conservation of Leadbeater's Possum. In 2016, harvest levels were reduced and are forecast to be further reduced by 2021 (VicForests 2017b). However, this has been in response to a lack of forecast yield available to mills primarily due to losses from the fires and past rates of cutting, not as a conservation response. The volume of pulp logs cut from the forests has not been reduced in line with the reduction in sawlog volume, with pulpwood harvesting forecast

to continue at existing high levels until 2030 due to legislation enacted by the Victorian Government in 1996 (Victorian Government 1996; Victorian Environmental Assessment Council 2017).

Failure to adopt more environmentally-sensitive timber harvesting systems

Clearfell logging operations have been the conventional silvicultural system employed in Mountain Ash forests over the past 40 years (Flint and Fagg 2007). These operations are relatively efficient at producing pulpwood and sawlogs but have significant negative environmental impacts at a range of spatial scales and over prolonged periods (spanning centuries) (reviewed by Lindenmayer 1994; Lindenmayer *et al.* 2015b), including impacts on Leadbeater's Possum.

A major meeting of silvicultural scientists, representatives of industry groups, government officials and conservation biologists was held in 2002 to facilitate a move away from clearfelling toward more environmentally-sensitive harvesting methods such as the Variable Retention Harvest System (VRHS) (Lindenmayer and Franklin 2003). A practical, on-the-ground VRHS experiment was established in 2003 and monitoring of it continues to this day (Lindenmayer *et al.* 2015a). However, since the initial experiment, VRHS has been employed only very rarely in Victorian Mountain Ash forests. This is despite statements by the Victorian Government that VRHS would be implemented on a minimum of 50% of logging coupes with an aim of 100% application if found to be 'operationally achievable' (Leadbeater's Possum Advisory Group 2014a). VRHS has been found to be operationally achievable, and is applied in many countries around the world including in Mountain Ash forests in Tasmania (Fedrowitz *et al.* 2014). Despite this, the timber release plan for the next

five years of harvesting in the Central Highlands region has 402 coupes proposed for logging, with less than 5% of those designated for harvesting using VRHS (VicForests 2017a).

Failure to consider the key science on effective conservation strategies such as forest reservation

Recent initiatives to conserve Leadbeater's Possum have been constrained by prioritising the maintenance of harvesting levels for the native forest logging industry. For example, the package of conservation strategies in the Victorian Government's Leadbeater's Possum Advisory Group Technical Report was limited to a maximum combined reduction of 5% in sustained yield (Leadbeater's Possum Advisory Group 2014a). This automatically precluded the most effective strategy of establishing a large formally protected area (Todd *et al.* 2016; Taylor *et al.* 2017) where some of the key processes threatening Leadbeater's Possum could be excluded or their effects reduced. The effectiveness and necessity of an expanded ecological reserve system has been demonstrated through work led by Victorian Government scientists (Todd *et al.* 2016) and others (Taylor *et al.* 2017). Instead, several of the State Government's recommendations for conserving Leadbeater's Possum were actions that were unproven and high risk (such as translocation of animals), or were ineffective or difficult, and expensive to implement and maintain at a meaningful scale (nest boxes and artificial hollows), but which would have limited effect on the timber industry.

Extensive scientific research in Mountain Ash forests has highlighted the critical need to protect existing large old hollow-bearing trees with buffers of unlogged forest. Indeed, this is one of the highest priority actions that should be adopted (Lindenmayer 2017), especially given the prolonged time required to recruit new large old trees as existing ones are lost

137 (Lindenmayer *et al.* 2012). To date, this recommendation has largely been ignored, resulting
138 in hundreds of large old trees being badly damaged during logging operations or by fires lit to
139 promote the regeneration of logged stands (Lindenmayer *et al.* 2016). We suggest that this
140 recommendation has most likely been rejected by the Victorian Government because of its
141 potential impacts on resource availability for the timber industry.

142

143 ***Retrogressive management zoning for forest protection***

144 The Victorian Government has employed a range of strategies to reduce levels of habitat
145 protection for Leadbeater's Possum. For example, it has altered long-standing definitions of
146 'mature' trees and 'old growth'. Based on definitions developed in the 1950s (Jacobs 1955),
147 mature trees were those that yielded sawlogs and, in Mountain Ash forests, were typically 60-
148 80+ years old. The main way Leadbeater's Possum habitat is protected is through a zoning
149 prescription underpinned by the density of 'mature' trees with hollows within a given area
150 (Macfarlane *et al.* 1995; Victorian Government Department of Environment and Primary
151 Industries 2014). By changing the previous definition to one that excludes trees younger than
152 120 years old, the vast majority of trees in logging coupes are no longer assessed. A number
153 of additional changes to the methodology of calculating the habitat zones has meant it is now
154 more difficult to find areas with the threshold density of hollow-bearing trees than it was
155 when the original prescriptions were developed over 20 years ago (Blair *et al.* 2017).

156

157 There also have been definitional changes to 'old growth' trees and stands. Previously, old
158 growth was deemed to occur when the senescence of Mountain Ash trees typically begins,
159 especially the development of hollows (120-150 years old) (Lindenmayer *et al.* 2017a).
160 However, trees must now be 250 years to be considered to be old growth (VicForests 2013;

161 Victorian Government Department of Environment and Primary Industries 2013; Blair *et al.*
162 2017). The result of this change is less protection for old growth trees, which now have an
163 additional century of growth required before prescriptions relating to their protection take
164 effect (Blair *et al.* 2017). This significantly weakens the protection of both large old trees and
165 habitat for Leadbeater's Possum. To the best of our collective understanding, neither of these
166 changes in definition of mature trees or old growth is based on credible empirical science.

167

168 ***Failure to recognize long-term declines in population and the continued threats to the***
169 ***conservation of the species***

170 A critical part of the conservation of any species is to quantify temporal changes in
171 populations. Due to a recent increase in the number of sightings of Leadbeater's Possum,
172 some forest industry advocates claim that populations of Leadbeater's Possum are increasing
173 and its Critically Endangered status should be downgraded (reviewed by Blair *et al.* 2017).
174 These recent additional records of Leadbeater's Possum are most likely a function of a
175 substantial increase in the amount of effort invested in trying to find animals after
176 prescriptions changed to buffer known colonies with areas of unlogged forest (Leadbeater's
177 Possum Advisory Group 2014a; b; Blair *et al.* 2017). Although buffering of known colonies
178 of animals is an improvement in protection, recent work suggests that the size of the buffers
179 may be inadequate (Lindenmayer *et al.* 2017b), and hence the effectiveness of long term
180 protection associated with this measure remains unclear.

181

182 The detection of more animals with greater search effort is a well-known phenomenon in
183 studies of other animals (such as tigers) but it does not mean populations are increasing
184 (Harihar *et al.* 2017). Rather, our large-scale, long-term monitoring work at over 160 field

sites located throughout the distribution of Leadbeater's Possum indicates the species is in significant decline (Figure 1). Leadbeater's Possum is not the only species undergoing major decline; the Greater Glider *Petauroides volans* – which is classified as Vulnerable – was formerly at 64% of our long-term sites (in 1997) and is now found at 24% of sites. This too is a highly statistically significant decline (Lindenmayer *et al*., unpublished data).

A critical oversight on the part of all 'initiatives' to better conserve Leadbeater's Possum has been a failure to address one of the key processes threatening the species – the rapid ongoing decline in large old trees. These trees are the sole form of natural nesting sites for the species (and indeed the Greater Glider as well as a suite of other hollow tree dependent species in the Mountain Ash forests of Victoria) (Lindenmayer *et al.* 2016). Our most recent work suggests that by 2040, populations of large old trees will be less than 10% of what they were in 1997. The paucity of large old trees and the significant risks facing the Mountain Ash forests in which Leadbeater's Possum lives has resulted in the forest ecosystem itself being classified as Critically Endangered under the IUCN formal process for assessment of Red Listed Ecosystems (Burns *et al.* 2015). It is unfortunate that no coherent policy or on-the-ground strategy has been developed (or implemented) to tackle the decline of large old hollow-bearing trees in Mountain Ash forests. Similarly, with logging planned in 5 yearly periods, the decision making cycle is not sufficiently long term to plan for the recruitment of new cohorts of hollow-bearing trees from stands that currently supply timber to sawmills and pulpmills.

Poor governance practices

The governance process for developing conservation measures for Leadbeater's Possum has changed markedly in the last 5 years. Prior to 2012, the government sought advice from expert ecologists on the most effective conservation measures. The government would subsequently try to balance these recommendations with their impacts on the timber industry and other stakeholders.

The current process appears to begin with input from the forest industry, which lacks conservation science credentials or expertise on Leadbeater's Possum. This precluded consideration of effective conservation measures that may affect the timber industry. Those with conservation management and forest ecology expertise (including those who study the species directly) have largely been excluded from input into the development of appropriate science-based recommendations. As a result, the most effective conservation options are not countenanced.

Failure to consider other forest values beyond timber harvesting

The Victorian Government currently has a limited view of the array of key values of Mountain Ash forests. Not only have there been substantial constraints on conservation efforts imposed by the desire to maintain the timber industry at current levels of sustained yield, but significant non-timber values have been given secondary consideration. Approaches such as economic and environmental accounting have been employed to quantify the relative contribution to the Victorian economy of different natural resource-based industries in the Central Highlands of Victoria (Keith *et al.* 2017a; Keith *et al.* 2017b). This work clearly shows that non-timber-based industries – water production and tourism –

231 contribute significantly more (25.5 and 21.6 times, respectively) to the Victorian economy
232 than the native forest logging industry. Moreover, native forest logging degrades water and
233 tourism values as well as biodiversity and carbon storage values (Keith *et al.* 2017a). For
234 example, intact old forests generate in excess of 12 megalitres per ha per year more water
235 than forests degraded by logging (Vertessy *et al.* 2001), and old forests on average store more
236 than twice the carbon of young (30 year old) forest (Keith *et al.* 2014). In addition, not
237 logging Mountain Ash forests would leave the Victorian economy significantly better off
238 than if logging continued (Keith *et al.* 2017a; Keith *et al.* 2017b).

239

240 Expanding the range of values considered in debates over the fate of Leadbeater's Possum
241 and the industry gives a broader perspective on rational economic use and protection of forest
242 resources in the Central Highlands region (Keith *et al.* 2017b). To date, the Victorian
243 Government has not been receptive to the results of economic and environmental accounting,
244 despite it having an entire section of its administration dedicated to the application of such
245 methods and advocating the use of the same approaches employed by Keith *et al* (2017a, b)
246 (and which are also used in 54 other countries worldwide).

247

248 **General Discussion**

249 Leadbeater's Possum is arguably one of the best studied Critically Endangered species
250 worldwide. Legislation to protect the species obliges the Victorian Government to guarantee
251 the species is able to 'survive, flourish and retain their potential for evolutionary development
252 in the wild', and to 'manage potentially threatening processes' (Victorian Government
253 Department of Environment and Primary Industries 2014). There is no shortage of high
254 quality information to guide best practice conservation management and evidence-based

policy. Indeed, there is a broad consensus among experts on the most appropriate and ecologically-effective strategies for the conservation of the species – that is, the establishment of a large protected area (Todd *et al.* 2016; Taylor *et al.* 2017). However, policies and practices for the conservation of Leadbeater's Possum do not reflect current scientific knowledge but rather a lack of political will to make rational decisions and a position that continues to favour one stakeholder (the timber industry) to the detriment of all others. This is underscored by recent analyses showing the substantial economic benefits that accrue from a change in land tenure from extensive and intensive wood production to conservation (Keith *et al.* 2017a, b).

The best way to resolve the current impasse on the conservation of Leadbeater's Possum remains unclear. The Government's Forest Industry Taskforce released a Statement of Intent in 2016, collaboratively written by timber industry and conservation groups, which stated "*the current 'business-as-usual' response to the many complex issues facing Victoria's forests is insufficient, and that to continue in this way will be of detriment to all stakeholders and the broader community*." (Forest Industry Taskforce 2016). Despite recognition of the unsustainable nature of current management for both industry and conservation, demonstrable positive change is yet to occur. Considerable time has been spent in the past decade outlining the need for policy and forest management reform. Communication efforts have engaged politicians (during which time there has been several changes in government), resource managers and the general public with literally thousands of hours dedicated to highlighting key and salient points arising from the intensive scientific research and monitoring programs (and more recently economic studies). It will be interesting to observe whether these efforts will eventually catalyse change in management or whether the status

279 quo continues to be maintained and with it, the ongoing demise of Leadbeater's Possum and
280 possibly other charismatic faunal icons like the Greater Glider.

281

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285

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393 Figure 1, suggested insertion location, line 190.

394

395 **Figure 1. Temporal changes in the proportion of sites occupied by Leadbeater's Possum**
396 **between 1997 and 2017. Note that the curve underestimates the extent of decline**
397 **because 16% of our long-term sites now no longer support large old hollow-bearing**
398 **trees (and also do not support animals) and have been excluded from the analysis.**
399 **(Dashed line is logistic regression, solid line is Generalised Additive Model).**