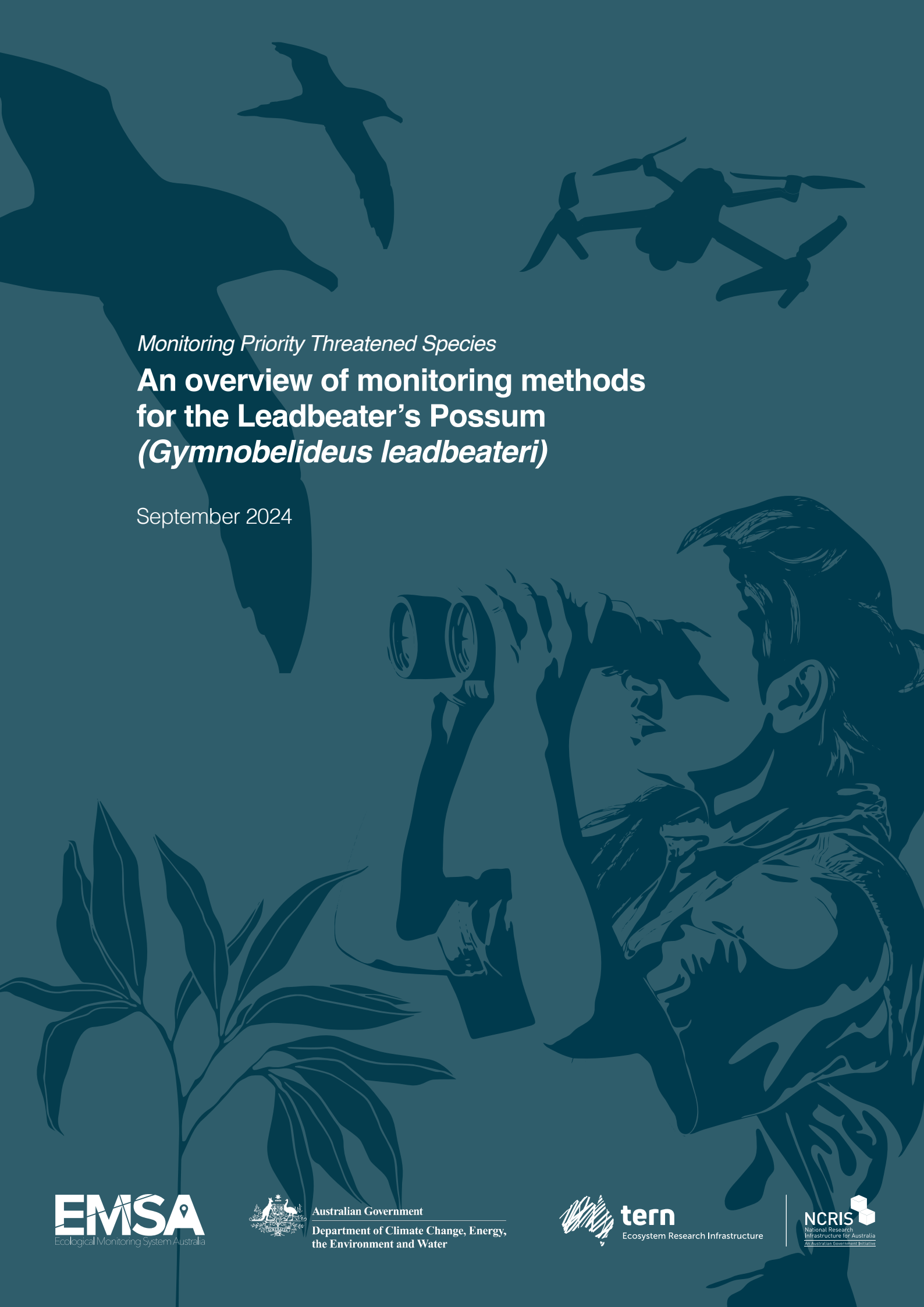




Monitoring Priority Threatened Species

An overview of monitoring methods for the Leadbeater's Possum (*Gymnobelideus leadbeateri*)

September 2024

Citation

TERN Australia (2024) Monitoring Priority Threatened Species: Overview of monitoring methods for the Leadbeater's Possum (*Gymnobelideus leadbeateri*). Version 1 Report to the Department of Climate Change, Energy the Environment and Water. TERN, Adelaide.

Version

Version 1.

Last updated: 2 September 2024

Acknowledgements and contributions

This work was funded by the Australian Government Department of Climate Change, Energy, the Environment and Water.

Acknowledgement of Country

We acknowledge the Traditional Custodians of Australia and their continuing connection to land and sea, waters, environment and community. We pay our respects to the Traditional Custodians of the lands we live and work on, their culture, and their Elders past and present.

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About

This literature overview collates information on one of the 110 priority threatened species identified in the *Threatened Species Action Plan 2022-2032* and has been reviewed by invited practitioners experienced in monitoring the species.

The *Survey Guidelines for Monitoring Threatened Species* project, a collaboration of the Department of Climate Change, Energy, the Environment, and Water (DCCEEW) and the Terrestrial Ecosystem Research Network (TERN), aims to improve our knowledge of threatened species by enhancing accessibility and sharing of quality scientific threatened species data. By developing best practice field survey guidelines and recommendations, practitioners will be better equipped to conduct standardised, repeatable surveys.

By identifying the monitoring methods typically implemented by practitioners, documenting and assessing the techniques known to work, and identifying opportunities to standardise the methods, we can move towards ensuring all monitoring is species-appropriate, comparable between practitioners and populations, and repeatable over time. Further, together with consistent terminology, guidelines, instructions, and data collection, we can refine efforts and resources to measure and share information. Data collected using robust, standardised methods will improve our knowledge of threatened species and underpin threatened species recovery at scale. This project is essential to establishing monitoring protocols and data repositories to enhance the accessibility and sharing of threatened species data.

TERN has prepared the literature overviews for the Department of Climate Change, Energy, the Environment, and Water. For further information, please visit the [EMSA Threatened Species Survey Guidelines](#) website. Additional information, particularly monitoring methods and techniques not included that should be considered, can be brought to the author's attention by emailing tern@adelaide.edu.au for consideration for future updates.



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1 Background

1.1 Conservation status and species trajectory

1.1.1 Current EPBC Act status

- Critically endangered

1.1.2 Summary of data held in the Threatened Species Index

The Threatened Species Index (TSX) provides reliable and robust measures of change in the relative abundance of Australia's threatened and near-threatened species at national, state and regional levels. Understanding these changes in species populations is crucial for monitoring Australia's conservation progress and allows users to measure and report on the benefits of conservation investments, and to justify and design targeted management responses. Currently, the index is restricted to birds, plants and mammals, with new groups to be added in the near future.

The table below summarises Leadbeater's Possum data held in the TSX. More information on the TSX, including how to contribute threatened species monitoring data to the index, can be found at tsx.org.au

TSX information	Leadbeater's Possum data held in the TSX
Data held in the TSX	Yes
Number of data sources	1
Number of unique sites	19
Average time series length	18.8
Average number of sampling years	17.2

1.2 Distribution

- Leadbeater's Possum are endemic to Victoria (TSSC 2019).
- They are Victoria's faunal state emblem.
- They consist of two genetically-distinct subpopulations that have historically occupied different habitats (Hansen *et al.* 2009).
- The distribution of the population in the Central Highlands of Victoria covers an area of approximately 70 x 80 km at altitudes between 400 - 1,200 m above sea level (Lindenmayer *et al.* 1989), and is patchily distributed (Macfarlane *et al.* 1997; TSSC 2019).
- The 'lowland population' occurs at Cockatoo Swamp near Yellingbo (Smales 1994) at altitudes of 110 m above sea level (Harley 2004), and within 181 ha of lowland floodplain forest, where less than 20 hectares provides suitable habitat (D. Harley 2014, pers. comm., cited in DEPI 2014).
- The small subpopulation is a surviving remnant of a lowland subpopulation that has historically been, and remains, isolated from others (Hansen *et al.* 2009).

1.3 Habitat

- The Leadbeater's Possum occurs in Montane Ash forest, dominated by *Eucalyptus regnans* (Mountain Ash), *E. delegatensis* (Alpine Ash) and *E. nitens* (Shining Gum) with dense *Acacia* understorey and an abundance of large hollow-bearing trees (Smith 1984; Lindenmayer *et al.* 1991).
- The species also inhabits sub-alpine woodland dominated by *E. pauciflora* (Snow Gum) containing a dense mid-storey of *Leptospermum grandifolium* (Mountain Tea Tree) along drainage lines or forest dominated by *E. camphora* (Mountain Swamp Gum) with a dense mid-storey of *Melaleuca* and *Leptospermum* species (Smales 1994; TSSC 2019).
- Prior to the 2009 fires, the greatest numbers were considered to occur at Lake Mountain, Mt Bullfight, and Mt Baw Baw (TSSC 2019).
- The patchy distribution of both nesting and food resources across ash forests contributes to the discontinuous distribution pattern of Leadbeater's Possum in the Central Highlands of Victoria (Lindenmayer and Cunningham 1996; Lindenmayer 2000).
- Leadbeater's Possum require large, hollow-bearing trees (for nesting sites and refuge) with large internal dimensions of at least 30 cm in diameter (Lindenmayer *et al.* 2013a). These trees are usually greater than 150 years old.
- Nest hollow availability is a limiting factor to population size (Lindenmayer *et al.* 1991; Lindenmayer *et al.* 1993a).
- Leadbeater's Possum require smooth-barked eucalypts or gum-barked eucalypts to provide shelter for insect prey and material for nests (Lindenmayer 1996; Harley 2004).
- They require structurally dense interlocking canopy or secondary tree layer of continuous interconnecting structure to facilitate movement (Lindenmayer 1996; Harley 2004).
- The area in which they occur is one of the world's most fire-prone environments, and several high-severity bushfires have occurred in the Central Highlands in the last century (Blair *et al.* 2017).

1.4 Ecology

- Leadbeater's Possums live in small groups of two to twelve individuals containing one breeding pair (Lindenmayer 1996).
- Observations of mating behaviour in captivity suggest that Leadbeater's Possum is strictly monogamous. Only one adult male per colony is reproductively active (Smith 1984) and a single adult female (Smith 1984; Harley and Lill 2007), although other studies have found colonies with two breeding females (Lindenmayer and Meggs 1996).
- Colonies live in territories that contain multiple den sites (Lindenmayer and Meggs 1996).
- They shelter in tree hollows during the day (Lindenmayer 1996).
- Nest trees are spaced close to the centre of a relatively exclusive home range (Smith 1984).
- They can breed twice a year (winter and spring), with a maximum of two young per litter in the highlands and breed year-round in the lowlands (Smith 1984; Harley and Lill 2007; Smith and Harley 2008; DSEWPC 2011).
- Among young adults, males outnumber females by three to one (Lindenmayer 1996) and the general adult population is thought to have a sex ratio approaching 3:1 (Smith 1984; TSSC 2019).
- Breeding is limited by the number of mature females (Lindenmayer 1996).

- Adult longevity is approximately ten years, and age at first breeding is typically two years (Lindenmayer *et al.* 1993b; Lindenmayer and Possingham 1995).
- Generation length is six years (TSSC 2019).
- Young remain in the pouch for 80-93 days (Harley 2005; Smith and Harley 2008), emerge from the nest at about 111 days, and remain in the natal territory for 7-14 months (for females) and 11-26 months (for males) (Smith 1980; Smith 1984; Menkhorst and Lumsden 1995).
- Monitoring at Yellingbo indicated that only about 20 % of young survived to acquire breeding status within established groups (Harley 2005; Harley *et al.* 2005) (DOE 2016).

1.5 Threats

- The greatest threats to the Leadbeater's Possum are the destruction and deterioration of habitat through fire, logging and additional causes (Yellingbo) (Blair *et al.* 2017; TSSC 2019).
- Fire can directly kill animals as well as destroy or alter habitat. Monitoring of montane ash forest sites before and after the 2009 bushfires demonstrated that few, if any Leadbeater's Possums, survive in areas burnt by bushfires, regardless of fire severity (Lindenmayer *et al.* 2013c; Lumsden *et al.* 2013).
- The threat of fire is likely to escalate based on climate change predictions of increasing frequency and intensity of fires.
- Low intensity fires can promote regeneration and formation of hollows in large old growth trees, however at least 20 years is required for stands to reach maturity (Lindenmayer *et al.* 2011).
- Harvesting methods such as clear-felling, followed by burning, result in direct mortality and threaten the habitat of the Leadbeater's Possum (TSSC 2019). This species is not found in clearfelled and regenerated montane ash forest due to a lack of hollows.
- At Yellingbo Nature Conservation Reserve, the habitat quality is declining due to eucalypt dieback and decreased regeneration, leading to a more open forest structure (TSSC 2019). This dieback is possibly a result of hydrological changes. The altered habitat has led to abandonment of territories and fragmented the population. Data between 1995 and 2004 estimated the population was between 80-100 individuals (Harley *et al.* 2005), but this has dropped to 40 individuals in 2014 (TSSC 2019).

2 Existing monitoring methods

2.1 Summary of existing methods used

- Direct observation
- Direct observation: special techniques (spotlighting, stagwatching)
- Signs (scats, tree scratches)
- Signs – DNA/eDNA/eRNA
- Camera trapping – remote cameras and thermal imaging
- Trapping – pitfall
- Trapping – Elliott/cage/or similar (ground)
- Trapping – Elliott/cage/or similar (in canopy)
- Refuge checks (checking nest boxes)
- Aerial surveys
- Invertebrate techniques
- Call playback

2.2 Existing survey requirements

- Optimal time of year/season/climate conditions (timing with resource availability, etc.)
 - Fine weather in spring, summer, or autumn appears to be the best time to monitor this species (Smith *et al.* 1989).
- Optimal location of surveys
 - Lake Mountain in the central highlands of Victoria (alpine population).
 - Yellingbo (lowland population) (Hansen *et al.* 2009).
 - Nearby locations to both populations in suitable habitat should be surveyed for new records.
- Minimum survey effort
 - Camera traps on site for 3–4 weeks (Nelson *et al.* 2017)
 - In this study, with the assistance of 500 volunteer observers (= 1200 person hours), 152 sites, each of 3 ha (= 456 ha of forest), were surveyed over 300 days and nights" (Lindenmayer *et al.* 1991)
 - Trapping over five consecutive days (Smith *et al.* 1989)
- Survey personnel
 - "groups of experienced volunteer observers ensured that all trees with hollows on any given site were stagwatched on the same night" (Lindenmayer *et al.* 1993a).
- Other factors:
 - The patchy distribution of both nesting and food resources contributes to discontinuous distribution pattern of Leadbeater's possum in the Central Highlands of Victoria (Lindenmayer and Cunningham 1996; Lindenmayer 2000).
 - Camera trapping has revealed that the possums use certain pathways within their home range and to forage (ARI, unpublished data). Camera traps should therefore be placed along these pathways to increase the likelihood of detection (Nelson *et al.* 2015).

- The Arthur Rylah Institute for Environmental Research use tree canopy specialists to install cameras at greater heights (up to 36 m) in montane ash forest (Nelson *et al.* 2015; Harley 2016).

2.3 Existing protocols

Existing protocols identified are identified in Table 1.

Table 1. Survey guidelines, protocols, and key resources that identify Leadbeater's Possum monitoring methods

Protocol	Comments	Reference
Survey guidelines for Australia's threatened mammals	Diurnal and spotlight surveys, active search for signs, stagwatching (locate dens/shelter sites during day, and watch 30 mins before dusk and continue until 60 minutes after sunset), arboreal hair sampling, cage trapping, nest box survey.	DSEWPC (2011)
Threatened species survey standard: Leadbeater's Possum	Details provided for stag-watching, call playback and remote camera surveys. Background information provided for spotlight counts and nest box surveys.	DELWP (2015)

2.4 Methods to consider further

The methods listed below have been identified as potential methods and techniques to survey for the species, either to identify presence or absence, or to assist determining population size and status. Further review of the literature and consultation with experts is required, particularly to identify and assess specific techniques for examining population ecology factors.

2.4.1 Available methods

- Stag-watching
 - Stagwatching (observing an old, possibly dead tree (stag tree) that has formed a nesting hollow) for 30 mins before and after dusk detected all species except the greater glider and common ringtail possum in greater numbers and at more sites than either spotlighting or trapping (Smith *et al.* 1989)
- Camera trapping (with or without bait stations)
- Thermal cameras – in association with other methods, e.g. call playback
- Active search (diurnal and spotlighting)
- Nest box survey

2.4.2 Additional methods

- Active search for signs (tree scratches, scats)
- Call playback

2.4.3 Methods to rule out

- All survey methods typical for mammals are considered suitable (no specific methods ruled out)
- Trapping – extremely difficult to capture in the wild and animals do not readily enter traps (Lindenmayer 1996).

2.4.4 Relevant Ecological Monitoring Standards Australia (EMSA) modules

The following Ecological Monitoring System Australia (EMSA) modules developed by TERN for the Australian Government should be considered for surveying the Leadbeater's Possum:

- Vertebrate fauna
- Opportune module
- Targeted module

In addition, the Plot description, Floristics, Cover, Soils, Condition and Vegetation mapping modules may be beneficial for assessing the suitability of a location against the species' habitat preferences.

2.4.5 Other 110 priority species with potential links

- None have been identified to date.

3 Considerations for survey guidelines and/or protocols development

Key considerations should a full literature review and/or survey guidelines be developed for the Leadbeater's Possum are highlighted below.

3.1.1 Special equipment required

- Hire of tree canopy specialists to install and manage high canopy cameras.

3.1.2 Estimated time and surveyor effort

- Not determined to date.

3.1.3 Vegetation communities or landscapes of the species' preferred habitat not suitable for the optimal survey methods

- None have been identified to date.

3.2 Key documents for further review

The documents listed below have been identified as key documents to review should a full literature review and/or survey guidelines be developed for the Leadbeater's Possum.

- Protocols
 - DSEWPC (2011). Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Australian Government Department of Sustainability, Environment, Water, Population and Communities.
 - DELWP (2015) Threatened species survey standard: Leadbeater's Possum. Department of Environment, Land, Water and Planning.
- Scientific papers and reports
 - Nelson, J.L., Lumsden, L.F., Durkin, L.K., Bryant, D.B., Macak, P.V., Cripps, J.K., Smith, S.J., Scroggie, M.P. and Cashmore, M.P. (2015). Targeted surveys for Leadbeater's possum in 2014–15. Report for the Leadbeater's Possum Implementation Committee. Arthur Rylah Institute for Environmental Research. Department of Environment, Land, Water and Planning, Victoria
 - DELWP (2015) Threatened Species Survey Standard: Leadbeater's Possum. Victoria Department of Environment, Land, Water and Planning
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3.3 Key agencies and organisations involved in the species research and recovery

- Dr David Lindenmayer, Australian National University
- Dr Dan Harley, Zoos Victoria
- Friends of Leadbeater's Possum Inc. <https://www.leadbeaters.org.au/>

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