

Designing reserves to save hollow dependent species in the forests of the Victorian Central Highlands

Key Messages

- Fire and logging are the key threats facing Leadbeater's Possums and other hollow-dependent species in the Victorian Central Highlands
- The most effective action that can be taken to save the Leadbeater's Possum, Greater Glider, Yellow-bellied Glider and Sooty Owl is to expand the reserve system to incorporate more habitat.
- Combining species distribution modelling, Population Viability Analysis and spatial prioritization provides the best guidance on how much land to reserve, where to reserve it and makes trade-offs between species transparent.

The fantastic four

The Mountain Ash forests of the Victorian Central Highlands are home to a number of threatened species that are dependent on old, hollow-bearing trees, including the Critically Endangered Leadbeater's Possum (*Gymnobelideus leadbeateri*). Other tree hollow-dependent species in these forests with similar needs are Greater Gliders (*Petauroides volans*), Yellow-bellied Gliders (*Petaurus australis*), and Sooty Owls (*Tyto tenebricosa*).

While their exact needs, in terms of home ranges and foraging needs are slightly different, the four all require large areas of intact forest with old trees which have large hollows for roosting or nesting. They also have in common that the main threats to their survival are fire and logging due to habitat loss and fragmentation.

Greater Sooty Owl (*Tyto tenebricosa*). Photo: Darren Bellerby CC BY 2.0 Flickr





Leadbeater's Possum (*Gymnobelideus leadbeateri*).
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Species in decline

The detection of Leadbeater's Possum across a long-term monitoring network of 175 sites across the Mountain Ash forests of the Victorian Central Highlands has declined by almost two thirds in the last 20 years, indicating a significant decline of the species. Greater Gliders have declined by half within the region over the last 20 years.

The 2009 'Black Saturday' fires dealt a heavy blow to Leadbeater's Possum, killing many animals and destroying 42% of remaining habitat. The four hollow-requiring species have been only rarely recorded in these areas since. This fire has increased the importance of subsequent conservation actions.

Essential action to save species

The most effective action that can be taken to save the Leadbeater's Possum, Greater Glider, Yellow-bellied Glider and Sooty Owl is to expand the reserve system to incorporate more habitat. Current reserves in the Victorian Central Highlands are inadequate to protect the four species.

As seen in Table 1, the existing reserve system across the region

captures between only 23.8% to 29.6% of available habitat for each species, while the Leadbeater's Possum Reserve, created specifically to conserve that species, contains only 7.6% of available habitat for that species, and less for the other species. Expanding the reserve system will be essential to the long-term survival of these species.

Species	Leadbeater's Reserve 30,500ha	Existing reserve network
Leadbeater's Possum	7.6%	29.6%
Greater Glider	4.2%	23.8%
Yellow-bellied Glider	3.4%	24.3%
Sooty Owl	4.8%	26%

Table 1. Available habitat for each species captured within Leadbeater's Reserve and the combined existing reserve network within the region.

Designing effective reserves

Effective reserves must address both adequacy (enough habitat for target species to persist) and representativeness (will protect all target species). To do this, we have combined three complementary research analysis techniques, Population Viability Analysis (PVA),

species distribution modelling, and spatial prioritization. This is something that has never been done for the Central Highlands area, and allows a much more comprehensive understanding of the system, and how different decisions trade off against each other.

Population Viability Analysis (PVA)

PVA was used to examine the total area of habitat required to ensure a greater than 95% chance that the population of Leadbeater's Possum would stay above 500 females over the next 200 years. This represented an acceptably low chance of population extinction in the foreseeable future.

Fire activity is expected to increase in future and the amount of suitable habitat will continue to decline. Two scenarios were used: Scenario 1 is favourable future conditions (only 12.5% of habitat burnt by fire and 12.5% decline in habitat) while Scenario 2 is less favourable conditions (50% of habitat burnt by fire and 50% decline in habitat).

The current area of the Leadbeater's Possum Reserve is 30,500ha. To achieve the population target specified above, under Scenario 1, the amount of habitat reserved must more than double, while under Scenario 2 over five times more habitat is required. Exact amounts are given in Table 2.

Although PVA can identify how **much** habitat to reserve, it does not identify **where** the habitat should be protected or which areas are the most important. This information can be supplied by species distribution modelling.

Scenario	Description	Area (ha)
Existing	Leadbeater's Possum Reserve	30,500
Scenario 1	More favourable future conditions (Fire only increases by 12.5%, habitat declines 12.5%)	67,473
Scenario 2	Less favourable future conditions (Fire increases by 50%, habitat declines 50%)	171,473

Table 2. The current size of the Leadbeater's Possum Reserve and the amount of land required to maintain at least 500 female Leadbeater's Possums for 200 years, under more favourable and less favourable future conditions.

Spatial Prioritization

Spatial prioritization was used to combine the Population Viability Analysis and species distribution models for each species to identify the optimal areas in the landscape where this habitat should be reserved. As the distribution of habitat for each species is slightly different, any one reserve design will benefit some species more than others. Spatial prioritization can define these trade-offs to make decisions more transparent.

A design that equally weighted the needs of each species was not optimal for Leadbeater's Possum. As the possum is the most Critically Endangered of the four species, it was given a higher weighting in the analysis. The benefits for all species in terms of the amount of habitat captured by the proposed reserve design are given in Table 3.

Scenario	Leadbeater's Reserve 30,500ha	Existing reserve network	Scenario 1 – favourable future conditions 67,473 ha	Scenario 2 – less favourable future conditions 171,473 ha
Leadbeater's Possum Reserve	7.6%	29.6%	38.1	61.5%
Greater Glider	4.2%	23.8%	25.8	35%
Yellow-bellied Glider	3.4%	24.3%	27.1	38.7%
Sooty Owl	4.8%	26%	36.5	43.5%

Table 3. The amount of habitat protected for each species within Leadbeater's Reserve, the total existing reserve network and when expanding the reserve area to support at least 500 female Leadbeater's Possums for the next 200 years (95% chance) under two future scenarios.

Species Distribution Modelling

Species distribution models take into account the environmental characteristics of the habitat used by each species, and can use that information to identify both existing and potential habitat. Although there is some overlap in the habitat of each of the four target species, as they have different ecological needs and their existing distribution and potential habitat areas are different. Species distribution modelling was used to compare how much habitat was captured by the Leadbeater's Possum Reserve (Table 1) and can also be used to identify the most suitable land to reserve when expanding reserve networks.

Yellow-bellied Glider (*Petaurus australis*)
Photo: David Cook NC 2.0 Flickr



General lessons for reserve design

- Trying to protect all species equally is challenging, and may mean we will do a worse job of protecting all species.
- When assessing trade-offs, providing more weight to species that are more threatened, will ensure that the most irreplaceable habitats are conserved and that the species requiring the most support receive it.
- Combining species distribution modelling, Population Viability Analysis and spatial prioritization provides the best guidance on how much land to reserve, where to reserve it, and makes trade-offs between species transparent.

Greater Glider (*Petauroides volans*)
Photo: Toby Hudson CC BY-SA 3.0 Wikimedia



Photo: ANU



Photo: ANU

Further Information

This factsheet summarises information from:

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