Managing the Great Dividing Range Long-footed Potoroo population



Key points:

- **Long-footed Potoroos are impacted by predation from foxes and severe bushfires.**
- **Long-footed Potoroos are more likely to be present in locations in which fox density is predicted to be lower.**
- **Long-footed Potoroos are more than three times more likely to be present in unburnt locations than in severely burnt locations.**
- **Modelling results suggest that an expanded fox control strategy could halve fox density, which could increase the occurrence of Long-footed Potoroos by 50%. Such an increase would substantially reduce the risk of extinction of the local Long-footed Potoroo population.**
- **Combining modelling approaches with population viability assessment provides the framework needed for adaptive monitoring assessment of long-term management effectiveness.**

Long-footed Potoroos

The Long-footed Potoroo (*Potorous longipes*) is an endangered, medium-sized, terrestrial rat-kangaroo known to inhabit forests in the Great Dividing Range of north-east Victoria and Gippsland. The Great Dividing Range population is centred on the Barry Mountains, a rugged mountainous area within this region.

The Long-footed Potoroo's poor conservation status, 'threatened' (as listed under the Victorian *Flora and Fauna Guarantee Act 1988*) and 'endangered' (in the Advisory List of Threatened Vertebrate Fauna – 2013), is based on its restricted and fragmented distribution, low population density, and vulnerability to predation by introduced Red Foxes (*Vulpes vulpes*; 'foxes'), Dingoes (*Canis familiaris*), their hybrids with wild dogs and Feral Cats (*Felis catus*). Inappropriate fire regimes and climate change are also thought to be threatening processes for Long-footed Potoroos.

A fox baiting strategy has been undertaken in the Barry Mountains to help maintain the Great Dividing Range Long-footed Potoroo population. The current core *Baseline* baiting strategy has been implemented since 2004, is coordinated by Parks Victoria and covers over 45,000 ha across all land tenures.

The *Baseline* strategy has been modified to manage access issues due to weather conditions and, since 2009, to manage negative interactions with hound hunters and the use of poison baiting in State Forest. This has resulted in a reduced fox control footprint relative to that of 2004–2009. The impact of these changes to the strategy on the status of Long-footed Potoroos is currently unknown. Further adding to uncertainty about the status of Long-footed Potoroos is the currently unknown impact of the 2019–2020 fires in this area, which burnt a considerable proportion of the suitable habitat of the Great Dividing Range population.

The Department of the Environment, Land, Water and Planning (DELWP), in partnership with Parks Victoria, Traditional Owners and the local community, are developing proposals for an expanded fox control strategy to ensure the long-term persistence of this population of Long-footed Potoroos.

Aim and objectives

The aim of this project was to provide data to DELWP and Parks Victoria to inform decisions on the future management of foxes and Long-footed Potoroos, i.e. to determine which management actions will provide the greatest likelihood of maintaining a viable Long-footed Potoroo population in northeast Victoria.

The project objectives were to:

- ascertain the presence/absence of Long-footed Potoroos in specified locations (using existing data and new observations), recording relevant habitat variables (including fire history) and management actions (e.g. fox baiting strategies)
- combine the Long-footed Potoroo presence/absence data with the estimated fox density at each location to determine the expected area of occupied habitat and Long-footed Potoroo population size under various fox management strategies and possible fire regimes.

Fox management

FoxNet is a computer model that predicts change in the density of foxes resulting from various control strategies and other parameters (Hradsky et al. 2019). FoxNet was used to predict changes in fox density in the Barry Mountains under three different control strategies: the current *Baseline strategy* (Fig. 1a) and two alternative strategies [*Core Expansion* (Fig. 1b) and *Ark Expansion* (Fig. 1c)].

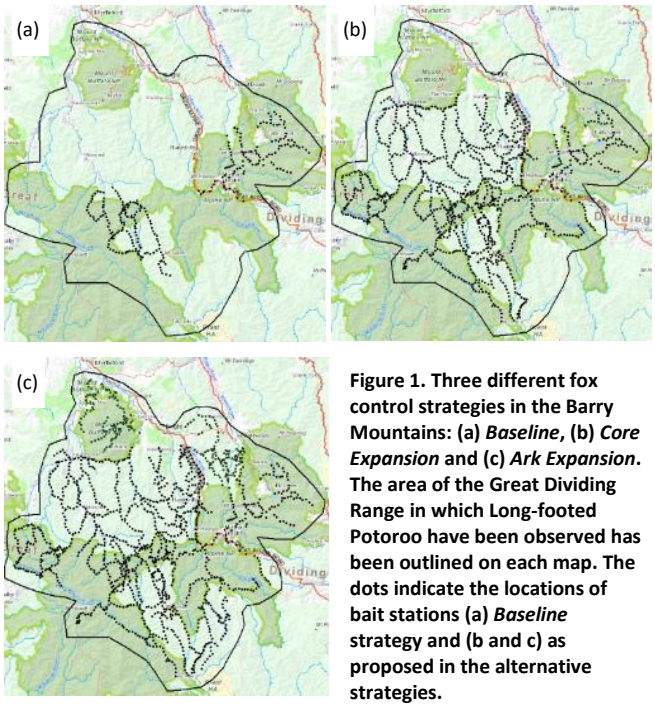

Figure 1. Three different fox control strategies in the Barry Mountains: (a) *Baseline*, (b) *Core Expansion* and (c) *Ark Expansion*. The area of the Great Dividing Range in which Long-footed Potoroo have been observed has been outlined on each map. The dots indicate the locations of bait stations (a) *Baseline* strategy and (b and c) as proposed in the alternative strategies.

The two expansion strategies incorporate several 10-day pulsed baiting periods across four of the six baiting zones to accommodate hound hunting between April and November. Baiting also occurs in two Parks Victoria zones, with baiting undertaken every fortnight in these zones when not snowbound. These strategies also compensate for lack of access or limited access to snow-bound areas during winter.

FoxNet can simulate populations of fox families across a landscape based on assumed rates of fox reproduction, survival, dispersal, and immigration, estimated habitat productivity, and estimated fox density. By providing an estimation of the rate at which foxes encounter baits, the model can be used to predict changes in fox density because of various management strategies. Here, FoxNet was used to classify the reductions in density into categories of <50%, 50–65% and >65%. The FoxNet model was also used to predict the percentage of the fox population's distribution area over which each category of fox density reduction would occur. The outcomes have been presented in the form of heat maps indicating the predicted sizes and locations of the fox density reductions (Fig. 2).

There was no substantial overall change in fox density after 10 years under the *Baseline* strategy (Fig. 2a). Under the *Core Expansion* strategy, fox density was reduced by 46% overall, with 30% of the area achieving >65% reduction in density (Fig. 2b). The *Ark Expansion* strategy reduced fox density by 59% overall, with 46% of the area achieving >65% reduction in fox density (Fig. 2c).

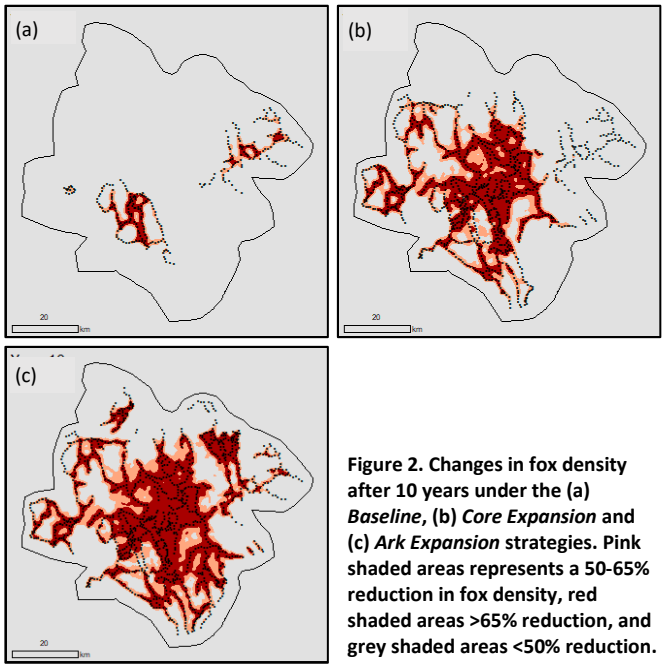

Figure 2. Changes in fox density after 10 years under the (a) *Baseline*, (b) *Core Expansion* and (c) *Ark Expansion* strategies. Pink shaded areas represents a 50-65% reduction in fox density, red shaded areas >65% reduction, and grey shaded areas <50% reduction.

Long-footed Potoroo occurrence

To assess the influence of fox control and fire on the occurrence of Long-footed Potoroo, we undertook surveys to update information on the presence of Long-footed Potoroo 10 months after the 2019–2020 fires. We deployed 120 camera traps across an area covering the Great Dividing Range population, both inside and outside fire-affected areas, inside and outside the current baited area, and across sites with high and low predicted Long-footed Potoroo habitat suitability. We combined this data with historical presence/absence data into models that predicted the most likely locations where potoroos would occur.

Long-footed Potoroos were more likely to occur in locations with lower predicted fox density, with 75% of sites with a predicted fox density of <0.25 foxes/sq km being occupied by potoroos, but only 25% of sites with a predicted fox density of >0.25 foxes/sq km being occupied. They were more than three times more likely to occur in unburnt locations than in severely burnt locations (Table 1).

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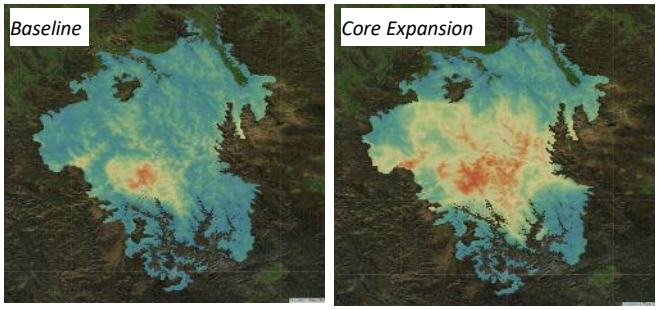
Table 1. Number of camera survey sites at which Long-footed Potoroos (LfPs) were detected for each fire category of areas burnt in the 2019-20 bushfires. Surveys were undertaken 10 months after the bushfires.

	LfP not detected	LfP detected	% detected
No fire	22	23	51%
Moderate fire	35	9	21%
Severe fire	28	3	10%
Total	85	35	29%

Compared with the *Baseline* strategy, the predicted area occupied by the Long-footed Potoroo was substantially higher under both the *Core Expansion* and *Ark Expansion* strategies (Fig. 3).



Predicted area occupied: 84,000 ha

Predicted area occupied: 129,000 ha

Predicted area occupied: 144,000 ha

Figure 3. Predicted occurrence of Long-footed Potoroos under the three fox control strategies. There is a high chance of potoroo occurrence in orange-shaded areas, with a lower chance of occurrence in blue-shaded areas.

Risk of Long-footed Potoroo extinction

We investigated the impacts of fox baiting and the frequency of severe fire on the risk of the Great Dividing Range Long-footed Potoroo population becoming extinct in the next 50 years. We linked potoroo survival to predicted fox densities (based on FoxNet modelling) and to incidence of severe fires under 12 main scenarios. These were combinations of the three baiting strategies (*Baseline*, *Core Expansion* and *Ark Expansion*) and four fire scenarios (0 to 3 severe (intense and widespread) fires over the next 50 years). For each fire scenario, we tested nine levels of impact on potoroos: combinations of three levels of immediate mortality (survival reduced by 10%, 25% or 50% in each year of fire) and three recovery periods (3-, 4- or 5-year periods for the potoroo annual survival rate to return to the pre-fire level).

We investigated the likelihood that the Long-footed Potoroo population would fall below 500 and 1000 individuals under the different scenarios. The Long-footed Potoroo population is considered highly likely to become extinct if it falls below 500 individuals (i.e. quasi-extinction). Information on survival and recruitment was taken from a 5-year study of the Long-footed Potoroo in Bellbird, Gippsland. In our study, we set initial survival rate at 0.66 and assumed that fox predation accounted for 5% or 10% of all Long-footed Potoroo mortality.

If fox predation is assumed to cause 10% of potoroo mortality, and the *Core Expansion* baiting strategy reduces foxes by 46%, then the risk of the population falling below 500 individuals over 50 years (i.e. a high risk of extinction) was shown by modelling to drop from 96% (with the *Baseline* baiting strategy) to 9% for the *Core Expansion* strategy (i.e. in 9% of 10,000 model runs, the population fell below 500 individuals) (Fig. 4).

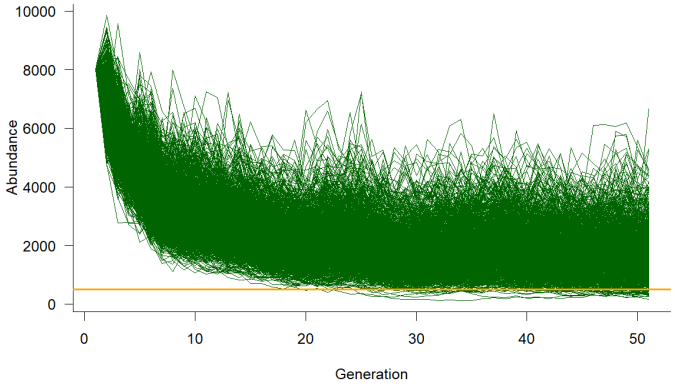


Figure 4. Local extinction risk for Long-footed Potoroos (LfPs) under the *Core Expansion* fox baiting strategy, assuming 10% of adult potoroo mortality is from fox predation. Green lines = outcomes from individual model simulations (*n* = 10,000). Orange line = LfP minimum population threshold (500). Only 9% of model runs resulted in a population below this.

The *Ark Expansion* baiting strategy further substantially reduced the probability that the Long-footed Potoroo population would fall below 500 or 1000 individuals (Fig. 5).

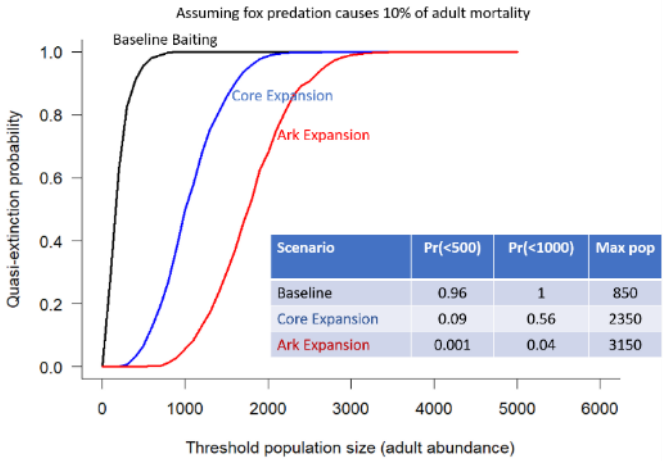


Figure 5. Chance of Long-footed Potoroo population falling below thresholds of 500 and 1000 individuals under three modelled fox control strategies.

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Severe fires increased extinction risks under the *Core Expansion* and *Ark Expansion* baiting strategies but did not negate the benefits of the expanded baiting. When underlying survival rates were 0.66 and higher, extinction risks were substantially lower under the expanded baiting strategies than under the *Baseline* strategy, regardless of the number or severity of fires. If potoroo survival rates fall below 0.56, severe fires tended to overwhelm any benefits of an expanded baiting, especially at lower levels of fox predation.

Results suggest that even the *Core Expansion* fox control strategy could halve fox density, increasing the prevalence of Long-footed Potoroos by 50%. The *Ark Expansion* control strategy could further reduce the risk of Long-footed Potoroo population extinction in north-east Victoria.

Summary

By using a fox population model, we have been able to show that an expanded baiting strategy is required to reduce fox densities to levels that will effectively control the fox population. We have shown that Long-footed Potoroo presence is likely to be higher in areas of low fox density, and that while potoroos survived the 2019-20 fires, they were more than three times more likely to occur in unburnt areas than in areas that were severely burnt.

To estimate the *actual* extinction risk for the Great Dividing Range Long-footed Potoroo population, data on the current population size and demographic rates (e.g. survival and fecundity rates) are needed. Nevertheless, we have shown that, across a wide range of plausible values for key parameters, simulated populations had much lower extinction risks under the expanded fox baiting scenarios than under the *Baseline* scenario.

By combining the modelled outcomes for the *Core Expansion* baiting strategy, the presence/absence of potoroos, and considering the impact of severe fires of varying frequency, we were able to show that the chances of Long-footed Potoroos becoming locally extinct over 50 years was very low (9%) if this management strategy was implemented.

These findings provide guidance for public land managers in the development of management plans for Long-footed Potoroos and other species at risk from fox predation in the Barry Mountains. The fox – Long-footed Potoroo modelling reported here allows a cost: benefit analysis of the alternative strategies, provides measurable targets for management action, and can guide adaptation of both the management actions and the methods of evaluation as new information becomes available.

Reference

Hradsky, B.A., Kelly, L.T., Robley, A. and Wintle, B.A. (2019). FoxNet: an individual-based model framework to support management of an invasive predator, the red fox. *Journal of Applied Ecology* **56**, 1460–1470.

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