

Glenelg Ark—2025 monitoring and evaluation update

A. Robley, P.D. Moloney and E. Le Duc

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Front cover photo: (a) Red Fox; (b) feral cat; (c) DEECA crew monitoring native species' and (d) setting bait station; (e) Long-nosed Potoroo; and (f) Southern Brown Bandicoot (photographer: Ethan Le Duc).

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Glenelg Ark—2025 monitoring and evaluation update

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Summary

Context:

The Glenelg Ark project, launched in 2005, aims to recover native mammal species threatened by Red Fox (*Vulpes vulpes*) predation. Continuous landscape-scale fox baiting began that year across 90,000 ha of state forest and national parks in south-western Victoria. Three vulnerable species were selected for monitoring because of their low numbers, fragmented distributions and susceptibility to fox predation: the Common Brushtail Possum (*Trichosurus vulpecula*), Long-nosed Potoroo (*Potorous tridactylus*) and Southern Brown Bandicoot (*Isodon obesulus*). This report provides an update on Glenelg Ark fox control and monitoring from 2005 to 2025, re-evaluating drivers of occupancy for the three target species, including factors beyond fox control, alongside updated monitoring outcomes.

Aims:

The aims of this report were to:

- update information on the outcomes of fox control and the responses of target native species as of 2025
- support land managers and policy groups in decision-making regarding the project's future directions.

Methods:

To evaluate differences in fox occurrence and native species response between areas with fox control (fox-control monitoring locations, FCMLs) and without fox control (no-fox-control monitoring locations, NFCMLs), presence/absence data from camera traps deployed in 2025 were added to data from 2005–2024. Data collection and analysis methods were consistent with Robley et al. (2024). Seven environmental factors were assessed in both FCMLs and NFCMLs to understand their influence on the occupancy of three targeted native species. To represent habitat type, we used two variables: (1) the Ecological Vegetation Division (EVD) Tall Mixed Forest (Eastern), and (2) 'other EVDs', which comprised several vegetation divisions where low detection rates of target species prevented their separate inclusion in the analysis.

We measured the success of fox control by examining four population parameters: (i) occupancy rate, (ii) colonisation rate (the rate at which new sites are occupied each year), (iii) site survival rate (the proportion of sites occupied in the previous year that are still occupied in the following year), and (iv) site growth rate (the rate at which the number of occupied sites increases over time). These metrics were compared between FCMLs and NFCMLs.

Bayesian multi-season occupancy models were used to analyse native species detection data from 240 monitoring sites, split between three FCMLs and three NFCMLs. Changes in site colonisation and survival rates of the three target native mammals were expressed as odds ratios (ORs), indicating the strength of the relationship between variables. Site growth rates for occupied sites were calculated.

An activity index for foxes and feral cats (*Felis catus*) was calculated from 2013 to 2025 as the number of detections per camera site, scaled to 1500 camera nights, and analysed using a negative binomial regression model within a Bayesian framework. In addition to the three target species, we calculated naïve occupancy rates for a range of native species.

Results:

Native species response

Common Brushtail Possum

From 2015 onwards, occupancy rates for Common Brushtail Possum were clearly higher at sites in FCMLs. As found in previous years, in 2025, the odds of a site remaining occupied was higher with proximity to native vegetation in Tall Mixed Forest. Unlike in previous years, the ruggedness of the terrain had a positive effect on site survival rate. The odds of site colonisation were higher in Tall Mixed Forest at lower elevations.

Since 2009, the difference in the average annual rate of sites increasing (site growth rate) between FCMLs and NFCMLs has been close to zero, suggesting that most available suitable habitat has been occupied.

Long-nosed Potoroo

Since 2008, there is continued strong evidence that the overall occupancy rate for Long-nosed Potoroo is higher in FCMLs than in NFCMLs.

As in previous years, the odds that a site remains occupied by Long-nosed Potoroos was influenced by the absence of fox control, with site survival rate decreasing the further away from water. Site survival rate increased with increased habitat wetness regardless of the presence of fox control.

Site colonisation was positively associated with fox control, the 'other EVDs' vegetation class and increases in elevation.

The difference in the average annual rate of sites increasing (site growth rate) between FCMLS and NFCMLs has been close to zero since 2008.

Southern Brown Bandicoot

Since 2006, there is continued strong evidence that the average occupancy rate for Southern Brown Bandicoots in FCMLs is greater than in NFCMLs.

Site survival rate was significantly higher closer to water in FCMLs, and at sites with higher elevation. Site survival rate was higher at sites with relatively recent fire history, declining steadily since fire regardless of the presence of fox control.

The annual average difference between FCMLs and NFCMLs in bandicoot occupancy growth rate was effectively zero. This indicates that there was no growth in site occupancy by Southern Brown Bandicoots from 2005 to 2024.

Other native species

One hundred and twenty-four native species were detected on cameras between 2013 and 2025 across both FCMLs and NFCMLs. There were no significant differences in naïve occupancy rates between FCMLs and NFCMLs for any species. The mean naïve occupancy (percentage of sites at which a species was detected) was highest for Black-tailed Wallabies (*Wallabia bicolor*), Red-necked Wallabies (*Notamacropus rufogriseus*) and Short-beaked Echidna (*Tachyglossus aculeatus*).

Fox and feral cat activity

Overall, the fox Activity Index in NFCMLs was three times higher than the fox Activity Index in FCMLs in 2025.

The feral cat Activity Index declined from 2013 to 2020 but has since marginally increased across all locations. Cat activity varied by location, with no strong evidence of a treatment effect. In 2025, cat activity was still lower across all locations than in 2013.

Detection rates

Detection device (camera traps and hair-tubing) influenced the estimated daily detection rate for each target species, although performance varied among species and no single device consistently provided the highest detection rates across all three species.

Conclusions and implications:

This year's update continues to show that long-term fox control at Glenelg Ark has benefited key native mammals, with higher occupancy of Common Brushtail Possums, Long-nosed Potoroos and Southern Brown Bandicoots in fox control areas than in areas without fox control. Fox activity remains lower where control occurs, and reduced fox predation appears to support improved colonisation and survival, particularly for Long-nosed Potoroo and Southern Brown Bandicoot.

However, the recovery response has largely stabilised, suggesting that fox control alone is no longer the only driver of outcomes. Habitat condition, vegetation type, fire history, water availability, elevation and predator interactions also influence species responses, with some relationships remaining uncertain.

Overall, the Glenelg Ark project provides strong evidence that sustained fox control can deliver measurable conservation benefits, but future management should also address broader ecological factors and the ongoing threat posed by feral cats.

The program's adaptive management framework allows for ongoing research and strategic planning to address knowledge gaps and unintended consequences. Further studies, particularly on feral cat

management and the response of species like the endangered Heath Mouse (*Pseudomys shortridgei*), are crucial for guiding future management strategies and funding priorities.

Here we provide recommendations for potential next steps in the monitoring program:

1. Continue the current monitoring to improve the estimates and model predictions for better informed management.
2. Review the variables used in the modelling and where appropriate update with both site-specific data and more representative remotely sensed variables that are available, e.g. the fraction of absorbed photosynthetically active radiation (FAPAR) as a more informative measure of changes in productivity.
3. Improve the assessment of fox and feral cat densities across all sites, through (i) data derived from genetic material collected from scats and/or (ii) the use of distance-sampling using data collected from camera traps.
4. Commence planning for the integration of feral cat control. A possible design for the rollout of feral cat control is provided in Robley et al. (2019). This approach would continue to add to the current long-term monitoring dataset but would allow for the integration of feral cat control.
5. Investigate opportunities to assess the response of small mammals to fox control, particularly the Heath Mouse.

1 Introduction

The Red Fox (*Vulpes vulpes*, hereafter the fox) has contributed to the decline and extinction of Australian mammals (Short and Smith 1994; Salo et al. 2007). Recovery of native mammals following sustained fox reduction has also been documented (McLeod et al. 2008).

Since 2005, the Glenelg Ark project has maintained continuous, landscape-scale fox baiting across 90,000 ha of state forest and national park in south-western Victoria. Monitoring and evaluation have focused on the effects of fox control on fox activity and occupancy of three native mammals vulnerable to fox predation: the Common Brushtail Possum (*Trichosurus vulpecula*), Long-nosed Potoroo (*Potorous tridactylus*) and Southern Brown Bandicoot (*Isodon obesulus*). These species were selected because of their low local abundance (Robley et al. 2011), patchy distributions (Menkhorst 1995) and susceptibility to fox predation (Seebeck 1978). Previous studies indicate positive responses of these species to reduced fox abundance (Kinnear et al. 2002; Arthur et al. 2012).

Predation may constrain these species to refuges that do not reflect their full habitat requirements. Under Hutchinson's (1978) niche concept, and as outlined by Kinnear et al. (1988), fox predation can restrict the realised niche by increasing dependence on shelter and nearby food resources. Reduced predation pressure may therefore allow niche expansion, as reported for the Black-flanked Rock-wallaby (*Petrogale lateralis*) following fox control (Kinnear et al. 2002). Such responses may be reflected in occupancy metrics through time.

Environmental factors also influence species distribution (MacKenzie et al. 2017). Accordingly, the Glenelg Ark's dynamic spatial occupancy models incorporated environmental explanatory variables to assess native species responses to fox control (Royle and Kéry 2007).

Fox control effectiveness was assessed using four parameters: (i) occupancy rate, (ii) colonisation rate, (iii) survival rate, and (iv) growth rate in the number of occupied sites. These metrics were compared between locations with and without ongoing fox control.

We predicted that effective fox control at Glenelg Ark would lead to niche expansion in the target species, indicated by:

1. higher colonisation rates associated with fox control, suggesting that reduced predation pressure allows populations to expand into new sites
2. higher site survival rates in areas with fewer foxes
3. greater overall growth rates at locations with fox control compared to those without fox control.

This annual report provides an update on the Glenelg Ark project, building on the previous report (Robley et al. 2024), and highlighting the project's progress in managing fox threats and monitoring the responses of three native species vulnerable to fox predation.

This report includes new data from the 2025 monitoring of the fox control operation and target native species. It introduces a revised occupancy modelling approach that incorporates plausible environmental variables to explore the drivers of species responses to reduced predation risk. Additionally, future directions for the monitoring and evaluation of Glenelg Ark are suggested, providing land managers, policymakers, and the community with the information needed to make informed decisions about the success and future of this large-scale fox control initiative.

2 Methods

Descriptions of the study site, fox control operation, data collection, and analytical approach are summarised below. For a full description see Robley et al. (2024).

2.1 Location

The Glenelg Ark operations area is in far south-western Victoria, near the township of Heywood ($38^{\circ}07'50''\text{S}$, $147^{\circ}37'45''\text{E}$), and encompasses 90,000 hectares of public land (Figure 1).

Fox control efforts have been concentrated in the southern half of the operations area to broadly reduce fox numbers across public lands. Ideally, random allocation of fox control across public land blocks would have enhanced the assessment's rigor by better isolating the impact of fox control ('the treatment') on native species occurrence ('the response'). However, this was not possible due to operational and logistic reasons.

Fox baiting was conducted using commercial shelf-stable baits containing either sodium fluoroacetate (1080) or para-aminopropiophenone (PAPP). These baits were buried at designated bait stations (Figure 1). The stations were checked, and any taken baits were replaced, every two weeks throughout the year.

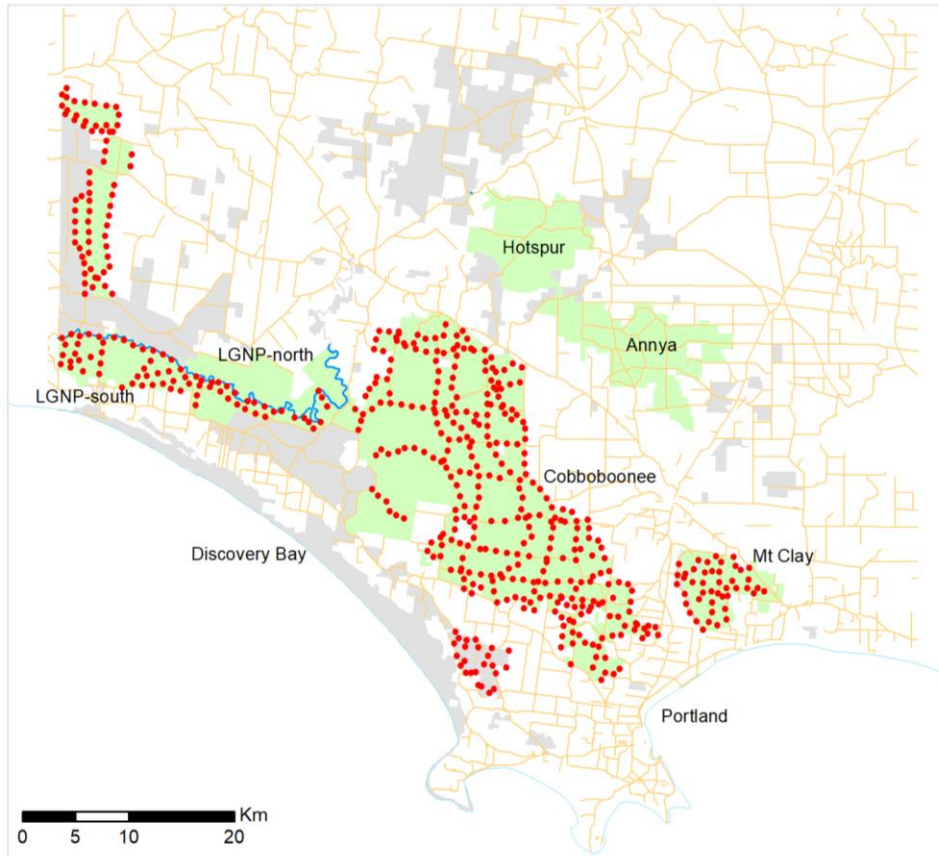


Figure 1. Glenelg Ark operational areas.

Green = Glenelg Ark operational areas; red dots indicate poison bait stations; pale grey = other public land.

2.2 Monitoring and evaluation design

Three fox-control monitoring locations (FCMLs) and three no-fox-control monitoring locations (NFCMLs) were used to assess the benefits of fox control to native species (Figure 2). There had been no fox control in the FCMLs and NFCMLs before 2005.

The monitoring locations were:

1. Annnya State Forest (NFCML; 8520 ha)
2. Hotspur State Forest (NFCML; 6940 ha)
3. Lower Glenelg National Park – North (LGNP-north; NFCML; 4659 ha) (separated from LGNP-south by the Glenelg River),
4. Cobboboonee National Park (FCML; 9750 ha)
5. Lower Glenelg National Park – South (LGNP-south; FCML; 8954 ha)
6. Mount Clay State Forest (FCML; 4703 ha).

2.3 Data collection

Monitoring was first conducted in winter 2005, before the commencement of poison baiting, and then was usually undertaken in spring (2005, 2008–2024). In 2006, monitoring was conducted in late winter, and the spring 2007 samplings at Mount Clay and Hotspur were delayed until the 2007–2008 summer.

Within each of the six locations, 40 monitoring sites were established (Figure 2). The placement of the monitoring sites was chosen based on descriptions of the habitat preferred by the target native mammal species (Menkhorst 1995) and aligned with Ecological Vegetation Classes (EVCs); the number of sites within an EVC was proportional to the size of the preferred habitat within each FCML and NFCML. The positions of the monitoring sites within locations were randomly assigned but constrained to be within 50 m of tracks. From 2005 to 2012, at each monitoring site, nine 'Handiglaze' hair-collection tubes (Murray 2005) baited with peanut butter, rolled oats, and golden syrup were set and checked daily for four consecutive days, with adhesive hair-collection tapes being replaced each day. These daily tape replacements represented four repeat surveys of the monitoring site per sampling period. Microscopic examination of hairs allowed for identification to species level.

Hair-tubing was discontinued from spring 2013, and a single digital camera (Reconyx RapidFire HC600, Reconyx, LLP Wisconsin, USA) was randomly set at one of four possible points within a hair-tube grid at each monitoring site. Cameras were attached to the nearest tree 20–30 cm above the ground. A lure of truffle oil, peanut butter, rolled oats, and golden syrup was secured to the ground in a small, ventilated container 2 m in front of the camera. Cameras were set to take five images per trigger and operated for a minimum of 30 days, with each day representing a repeat survey of the monitoring site per sampling period.

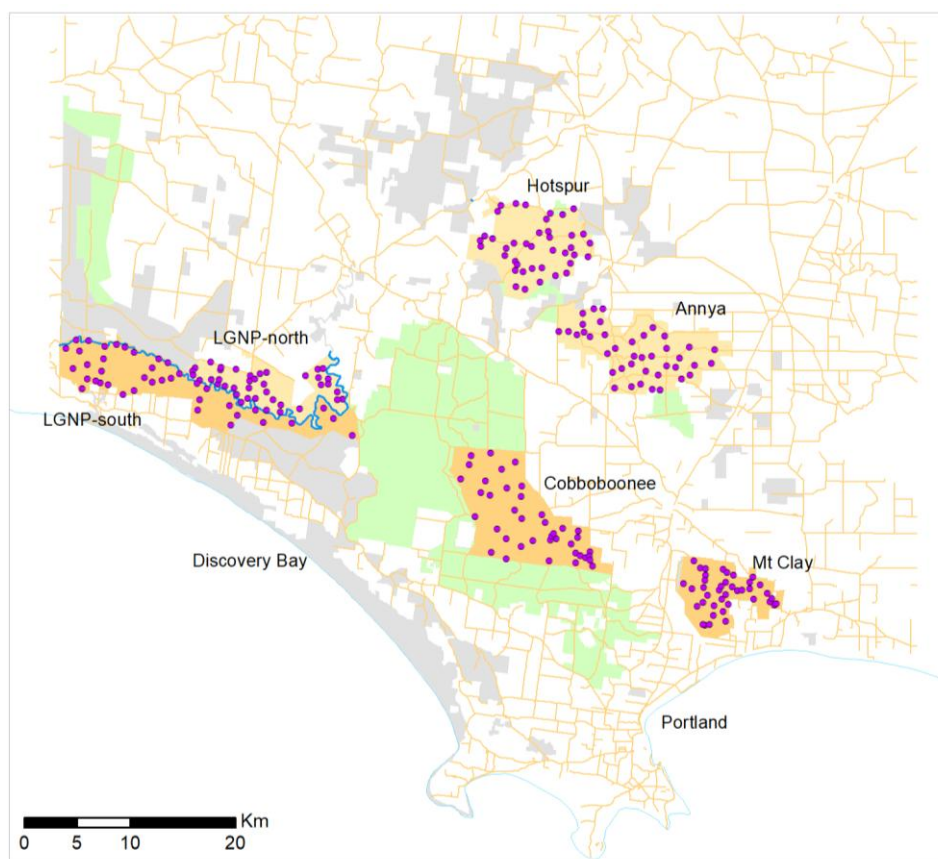


Figure 2. Monitoring sites in the ‘fox-control monitoring locations’ (FCMLs; dark-tan areas) and ‘no-fox-control monitoring locations’ (NFCMLs; pale-tan areas) are indicated by purple dots.

Green = Glenelg Ark operational areas; pale grey = other public land; LGNP = Lower Glenelg National Park.

2.4 Species occupancy

A multi-season occupancy model (MacKenzie et al. 2017) was utilised to estimate occupancy (ψ), detection (p), local colonisation (γ), and local survival (η) rates for the Common Brushtail Possum, Long-nosed Potoroo, and Southern Brown Bandicoot. The model was developed in a Bayesian framework using a space-state formulation (Royle and Kéry 2007) and considered six locations, three with fox control (Cobboboonee National Park, Mount Clay State Forest, and Lower Glenelg National Park – South) and three without (Annys State Forest, Hotspur State Forest, and Lower Glenelg National Park – North) – with all six locations considered fixed effects in the model.

The models included several site-level covariates affecting the local survival and colonisation rates (Table 1). The model comparisons and analyses were performed using Bayesian methods to determine the impact of these covariates on the occupancy dynamics of the target species.

If there was evidence that the covariate was important (i.e. the 95% high-density interval or 95% confidence interval excluded 0), then that covariate was included in a combined model for that rate. Only the final combined model has been reported (see Table A2 for definitions of the model parameters).

Table 1. Description of the site-level covariates used in the multi-season occupancy models.

Covariate	Description
Distance to non-native vegetation (DTNV) patches of >30 ha	Distance in metres to the nearest patch (>30 ha) of non-native vegetation, e.g. pine plantation, open pasture. Invasive predators can prefer habitat at the edges, so the distance to substantial non-native vegetation was considered (DELWP 2019; Geary et al. 2020).
Distance to water (DTW)	The distance to the nearest stream, river or permanent wetland from the camera monitoring station (in metres). Reflects habitat complexity and productivity, influencing shelter and food availability (Beven and Kirby 1979).
Elevation	The elevation (m) above sea level of the camera station. Influences rainfall, moisture, and temperature gradients, affecting resource availability.
Vegetation group	Two categories were used to describe vegetation groups representing habitat – one was the Ecological Vegetation Division (EVD) Tall Mixed Forest (Eastern) and the second comprised all ‘other EVDs’.
Terrain Ruggedness Index (TRI)	A measure of the difference in elevation between a centre cell and the eight cells directly surrounding it. The eight elevation differences were squared and averaged. The square root of this average result was a TRI measurement for the centre cell. High ruggedness can limit predator movement and predation rates (Hohnen et al. 2016; McDonald et al. 2017; Stobo-Wilson et al. 2020).
Time-since-fire (TSF)	Time (in years) since the camera site was last recorded as being burnt. Used to account for the time since the last fire, impacting habitat structure and resources (food and shelter).
Topographic Wetness Index (TWI)	A quantitative measure of the terrain-driven variation in soil moisture. TWI is calculated as the natural logarithm (specific catchment area/slope) and estimates the relative wetness at a camera site. TWI impacts vegetation and food sources (Beven and Kirkby 1979; Lobert 1990; Riley et al. 1999; Gallant and Austin 2012; Nuske et al. 2017; DELWP 2020).
Treatment	A binary variable indicating the presence or absence of fox control at a location (0 = no fox control, 1 = fox control).

The models accounted for variations in daily detection rates depending on whether a hair-tube or camera was used for detection. Additionally, they considered differences in Long-nosed Potoroo and Southern Brown Bandicoot detection based on whether Common Brushtail Possums were detected (hair-tube sample) at the site. This adjustment was made because hair-tubes could be overwhelmed with Common Brushtail Possum hairs, potentially hindering the collection of hair from other species, and leading to the underreporting of Long-nosed Potoroos and Southern Brown Bandicoots when Common Brushtail Possums were present.

Odds ratio

The model calculates colonisation and survival equations in the log-odds (logit) scale, which can range from negative to positive infinity. These parameters are transformed into a more interpretable scale when discussing their effects by using the odds ratio (OR). The OR measures the strength of the association between an explanatory variable and an outcome and can range from zero to infinity. It represents the ratio of the odds of an outcome occurring given a particular event to the odds of the outcome not occurring. An OR less than 1 indicates a decrease in the odds of the event occurring, while an OR greater than 1 indicates an increase. An OR of 1 suggests no detectable effect. For instance, if the chance of detecting a bandicoot at a NFCML is 20%, the odds would be 0.25:1. If the chance at a FCMLs is 60%, the odds would be 1.5:1. Comparing these odds, the OR for detection at a fox control site would be 6, implying a six-fold increase in the odds of detection compared to a no fox control site. Applying this OR to a different area where the detection rate without fox control is 10% (=0.111 odds), we would expect a 40% (=0.666 odds) chance of detection at a fox control site.

Growth rate

We derived the growth rate from the posterior distributions for the number of occupied sites. The growth rate compares the current occupancy rate with the previous season's rate:

$$Growth_t = \frac{\psi_t}{\psi_{t-1}}$$

A growth rate greater than 1 indicates increasing occupancy, while a rate less than 1 indicates decreasing occupancy. A rate of 1 shows no change. To assess the impact of fox control on growth rates, we converted the average growth rate to a percentage and calculated the difference between locations with and without fox control. For instance, if the annual growth rates in FCMLs were 110%, 120%, 110%, and in NFCMLs were 90%, 100%, and 110%, the net change would be 144%, with a geometric mean of 106.2%, indicating a 6% annual increase in site occupancy.

The models were constructed in JAGS (Plummer 2003) via R (R Core Team 2022) using the package R2jags (Su and Yajima 2015). Convergence was achieved when the Gelman-Rubin convergence diagnostic (scale reduction factor) was less than 1.05 for all parameters (Gelman et al. 2004). Model selection involved running models with each variable separately and including a variable in the final model if its 95% confidence interval excluded 0, indicating its importance.

2.5 Predator activity

From 2013 to 2025, we used presence and absence data from 40 camera traps in three FCMLs and three NFCMLs to calculate an Activity Index for foxes and feral cats to assess change in relative abundance over time and between the FCMLs and the NFCMLs.

The annual Activity Index was scaled to 1,500 camera nights. For foxes, it was analysed using a negative binomial regression within a Bayesian framework (McCarthy 2007; Hilbe 2011). Activity was also assessed using Generalised Additive Models (GAMs) – flexible statistical models that allow gradual, non-linear changes over time to be estimated without imposing a strict shape (e.g. straight line) (Wood 2017). The models were fitted using a thin plate regression spline.

Five models were developed to explore differences between locations and temporal changes.

1. **Null Model:** Assumes the Activity Index is constant across all locations and years.
2. **Location Model:** Assumes the Activity Index varies by location but is constant over years.
3. **Independent Location and Year Model:** Assumes the Activity Index varies independently across locations and years.
4. **Interacting Location and Year Model:** Assumes the Activity Index varies by year for each location separately.
5. **Location and Year Model:** Assumes that there is no interaction between years and fox-control level, with the Activity Index varying independently across locations and years.

For the GAMs:

1. **Smoothed year model:** Assumes a non-linear change in activity over time, consistent across all locations.
2. **Smother year by treatment model:** Assumes a non-linear change in activity over time, that can vary between fox-control types.

Model comparison was done using leave-one-out cross-validation, with significance determined by 95% credible intervals excluding zero. Bayesian models were constructed in STAN (Carpenter et al. 2017) using the brms package (Bürkner 2017) in R (R Core Team 2021), with non-informative priors and No-U-Turn sampling. Convergence was confirmed visually and with the Gelman-Rubin diagnostic (Gelman et al. 2004), ensuring model adequacy through residual plots and posterior predictive checks.

3 Results

3.1 Initial occupancy, survival, colonisation, and growth rates

Several environmental variables were included in the final model for the three target native mammal species. There were no single environmental variables or set of variables that consistently explained relationships with the odds of a site being occupied, surviving, or being colonised for any of the three species. The presence of fox control at locations was positively associated with the odds a site was both colonised and persisted for Long-nosed Potoroos and Southern Brown Bandicoots, and in combination with other variables for Common Brushtail Possums.

3.1.1 Common Brushtail Possum

Occupancy

None of the modelled covariates were important for determining initial occupancy, i.e. occupancy in 2005 pre-baiting (Table A3-A).

Across all locations, the number of occupied sites increased steadily from 2005 to 2009, declined from 2009 to 2011, and then increased again, remaining relatively stable from 2018 to 2020. Occupancy declined again in 2021 but has shown signs of recovery since. From 2015 onwards, occupancy rates were clearly higher at sites with fox control (Figure 3).

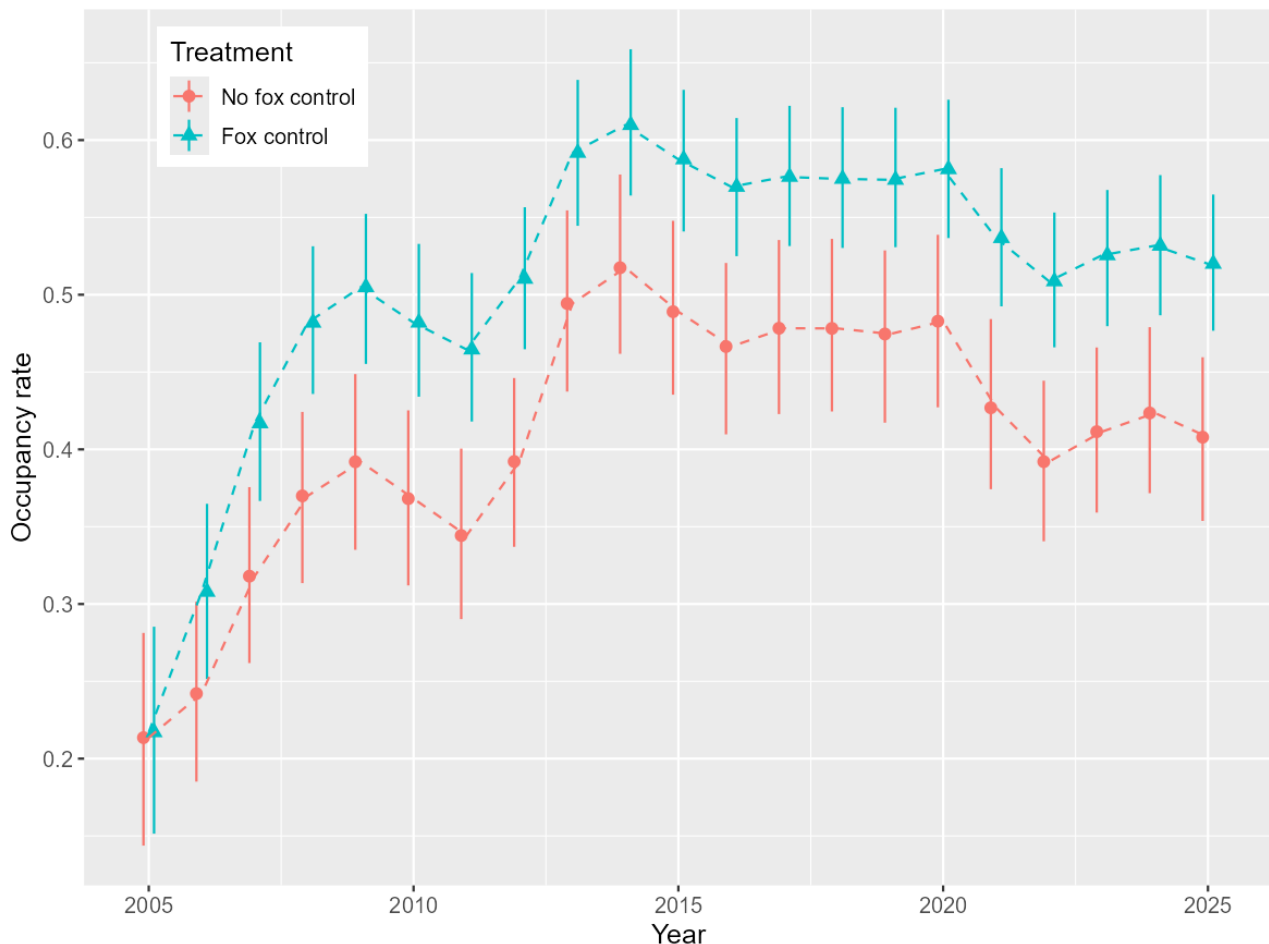


Figure 3. Occupancy rates (0-1) for the Common Brushtail Possum (*Trichosurus vulpecula*) over time by fox-control treatment.

The symbols indicate the median fitted values, and the bars represent the 95% credible intervals.

Site survival rate

As in previous years, the odds of a site remaining occupied or not by a Common Brushtail Possum was influenced by the distance a site was from native vegetation, the EVD class it was in and the presence of fox control. Unlike in previous years, the ruggedness of the terrain was also influential, and site survival rate was also dependant on vegetation class and fox control.

Possum site survival rates tended to be greater at sites closer to native vegetation in Tall Mixed Forest with fox control, at lower elevations in more rugged terrain. For every 1 km closer to native vegetation, the odds of possum site survival increased by 83% in FCMLs (OR = 1.83, 95% credible interval (CI): 1.24–2.78) compared to at sites with none (60% [0.60, 95% CI: 0.44–0.84]) (Table A3-B; Figure 4). At locations in Tall Mixed Forest the odds of survival were 58% greater than in other EVDs regardless of fox-control treatment (OR = 1.58, 95% CI: 1.04–2.38) (Table A3-B; Figure 4).

With every 40 m increase in elevation, there was a 24% decline in the odds of possum site survival (Table A3-B; Figure 4).

As terrain ruggedness increased, there was a 75% increase in the odds a site would remain occupied in FCMLs, but site survival remained constant in NFCMLs, regardless of the vegetation class (OR = 1.75, 95% CI: 1.06–2.91) (Table A3-B; Figure 4).

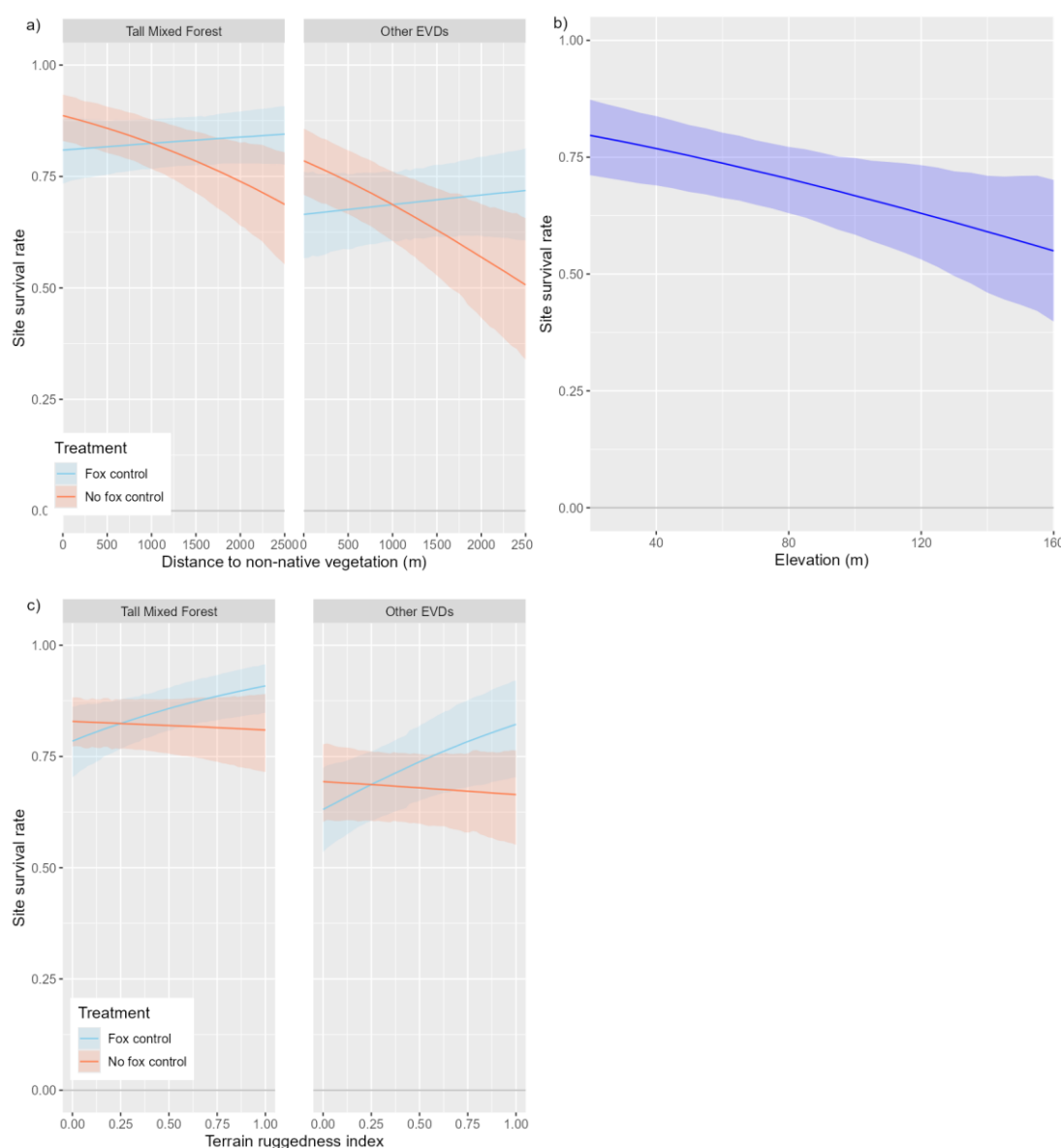


Figure 4. Estimated site survival rates for the Common Brushtail Possum (*Trichosurus vulpecula*) in relation to (a) the distance to non-native vegetation by Ecological Vegetation Division (EVD), (b) elevation given all other covariates were held at their mean values, and (c) terrain ruggedness by EVDs.

The lines indicate the median fitted values, and the shaded area represent the 95% credible intervals.

Site colonisation rate

As in previous years, the odds of a site becoming occupied by Common Brushtail Possums were influenced by vegetation class, fox control and elevation. Possums tended to colonise sites in Tall Mixed Forest with fox control at lower elevations.

There was a three-fold increase in the odds a site was colonised in Tall Mixed Forest with fox control compared to in NFCMLs (3.15, 95% CI: 1.78–5.92). The odds a site was colonised declined by 24% with every 40 m increase in elevation regardless of fox control (0.76, 95% CI: 0.61–0.95) (Table A3-C; Figure 5).

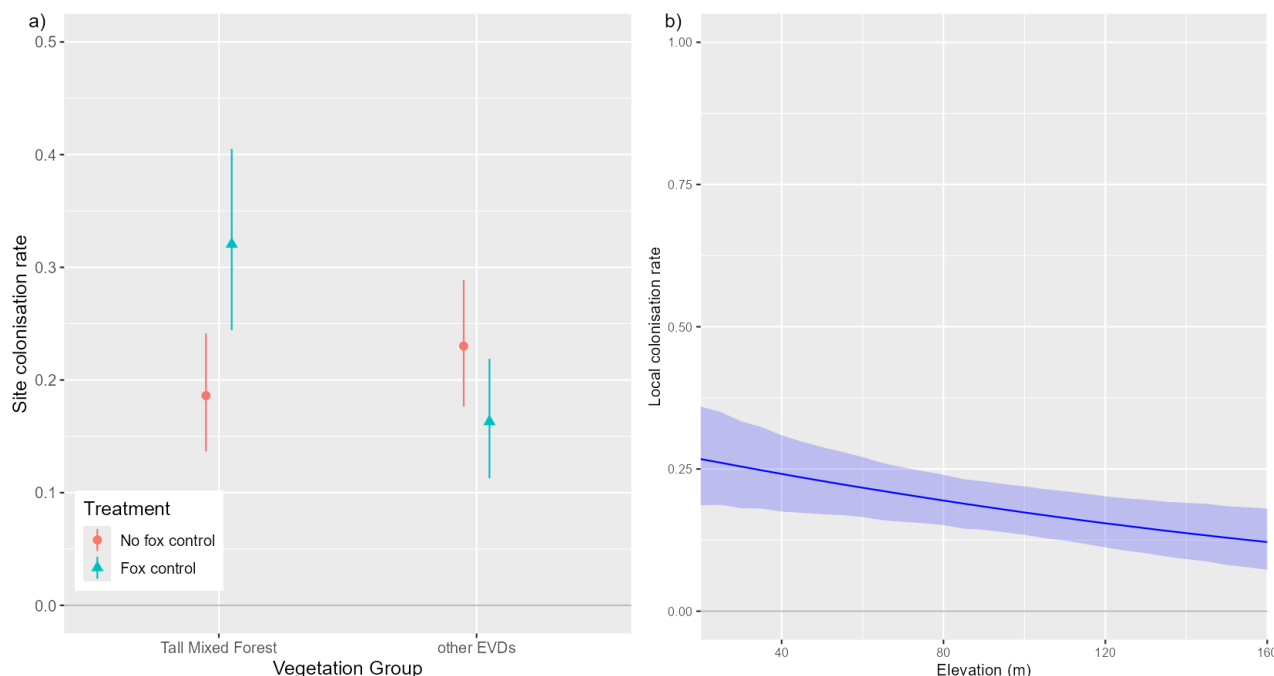


Figure 5. Estimated site colonisation rates (0-1) for the Common Brushtail Possum in relation to a) Ecological Vegetation Division (EVD), given all other covariates were held at their mean values and b) increasing elevation.

The symbols indicate the median fitted values, and the bars represent the 95% credible intervals.

Site growth rates

The annual average growth rate of Common Brushtail Possum occupancy in NFCMLs was 101% (95% CI: 100–104%), while in FCMLs the growth rate was 101% (95% CI: 102–104%). There was no difference in average annual growth rate (0%, 95% CI: -1–1%) at sites in FCMLs compared to at sites in NFCMLs.

3.1.2 Long-nosed Potoroo

Occupancy

None of the modelled covariates were important for determining initial (pre-fox-control) occupancy (Table A4-A).

There is continued strong evidence since 2008 that the average occupancy rate for Long-nosed Potoroo is higher at sites with fox control than those without (Figure 6). There has been a steady decline in occupancy since 2023; however, similar declines were present from 2006–2008 and 2014–2016. For both times, a recovery in the ensuing years has followed.

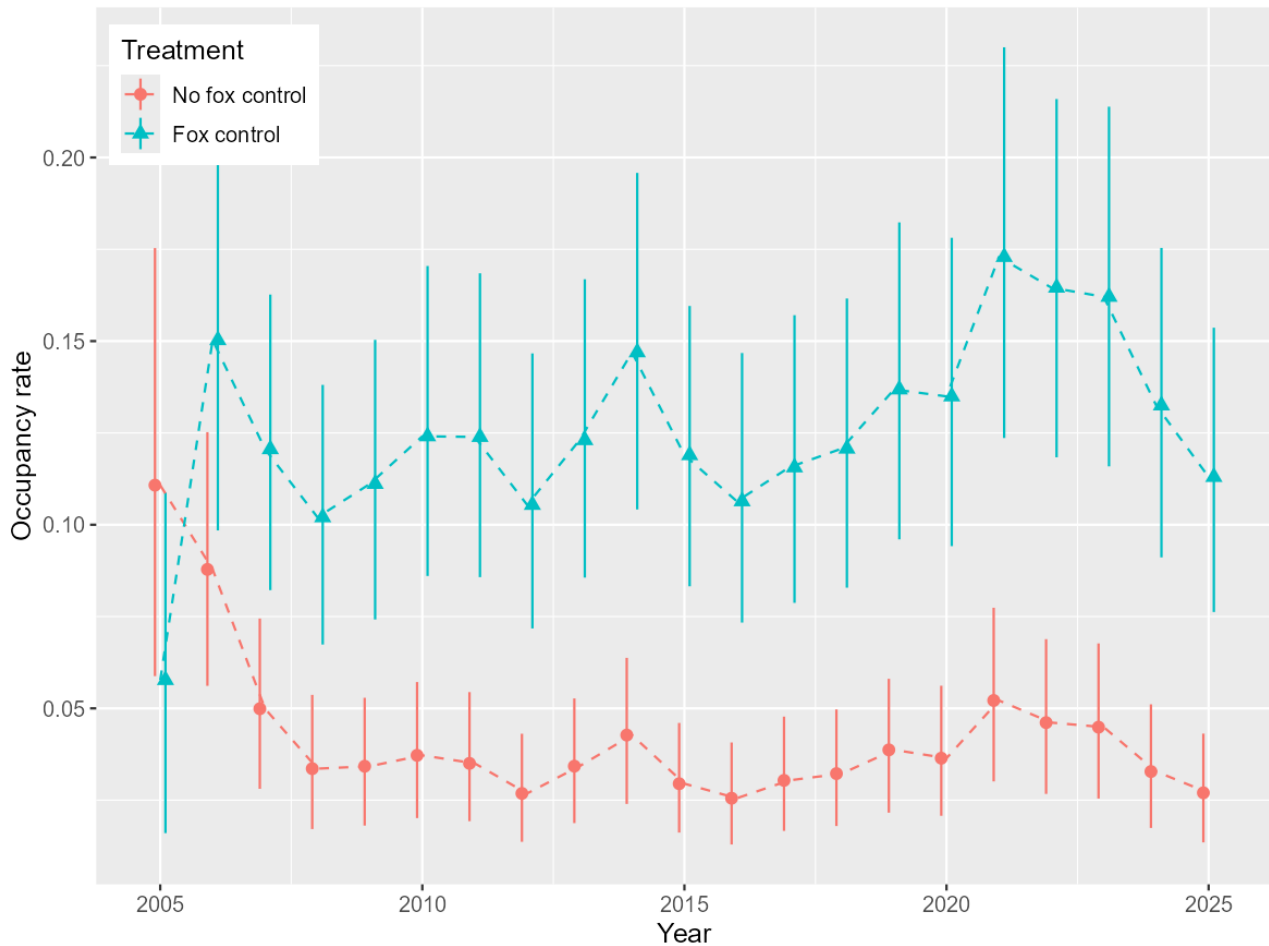


Figure 6. Occupancy rates for the Long-nosed Potoroo over time (2005–2025) by fox-control treatment.

The symbols indicate the median fitted values, and the bars represent the 95% credible intervals.

Site survival rate

As in previous years, the odds a site remains occupied by Long-nosed Potoroos was influenced by distance to nearest water and the wetness of the habitat.

There was a 42% decline with every 500 m away from water in NFCMLs (OR = 0.47, 95% CI: 0.21–1.01; Table A4-B; Figure 7), while there was minor change in site survival rate as distance increased in FCMLs. However, compared to in NFCMLs, the odds of site survival rate increased two-fold (OR = 2.01, 95% CI: 0.86–5.09; Table A4-B; Figure 7) in FCMLs.

For every two-unit increase in habitat wetness, the odds a site remained occupied increased by just over two-fold (OR = 2.34, 95% CI: 1.14–4.91) (Table A4-B; Figure 7).

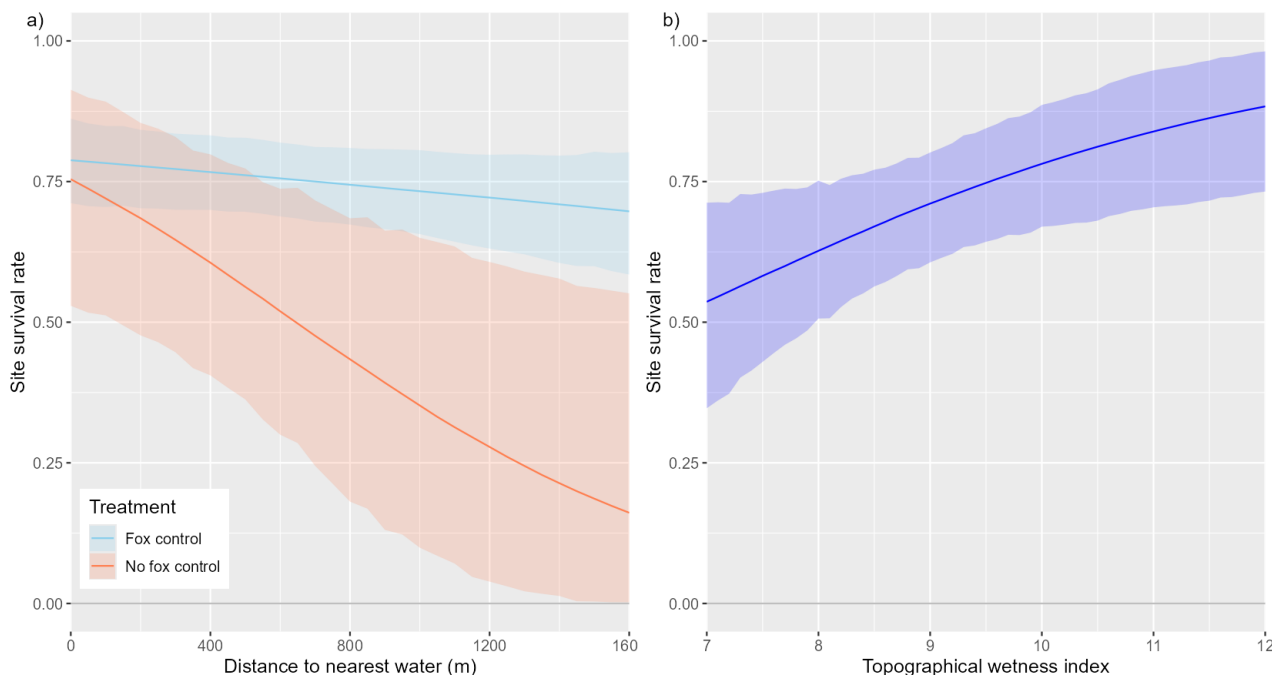


Figure 7. Estimated site survival rates for the Long-nosed Potoroo a) in relation to distance to nearest water, by fox-control treatment, and b) Topographical Wetness Index, given all other covariates were held at their mean values.

The lines indicate the median fitted values, and the shaded areas represent the 95% credible intervals.

Site colonisation rate

As in previous years, the odds of a site becoming occupied by Long-nosed Potoroos was influenced by vegetation class, fox control and elevation. Potoroos tended to colonise sites in Tall Mixed Forest with fox control at higher elevations.

The presence of fox control increased the odds of an unoccupied site becoming occupied by a factor of 21 (OR = 21.2, 95% CI: 10.24–45.11).

Site colonisation was higher by a factor of three in other EVDs than in Tall Mixed Forest (OR = 3.04, 95% CI: 1.26–7.21).

With every 50 m decrease in elevation, the odds a site was occupied decreased by 93% (OR = 0.07, 95% CI: 0.02–0.21).

Colonisation rates were consistently low and did not differ between vegetation types or vary with elevation in NFCMLs (Table A4-C; Figure 8).

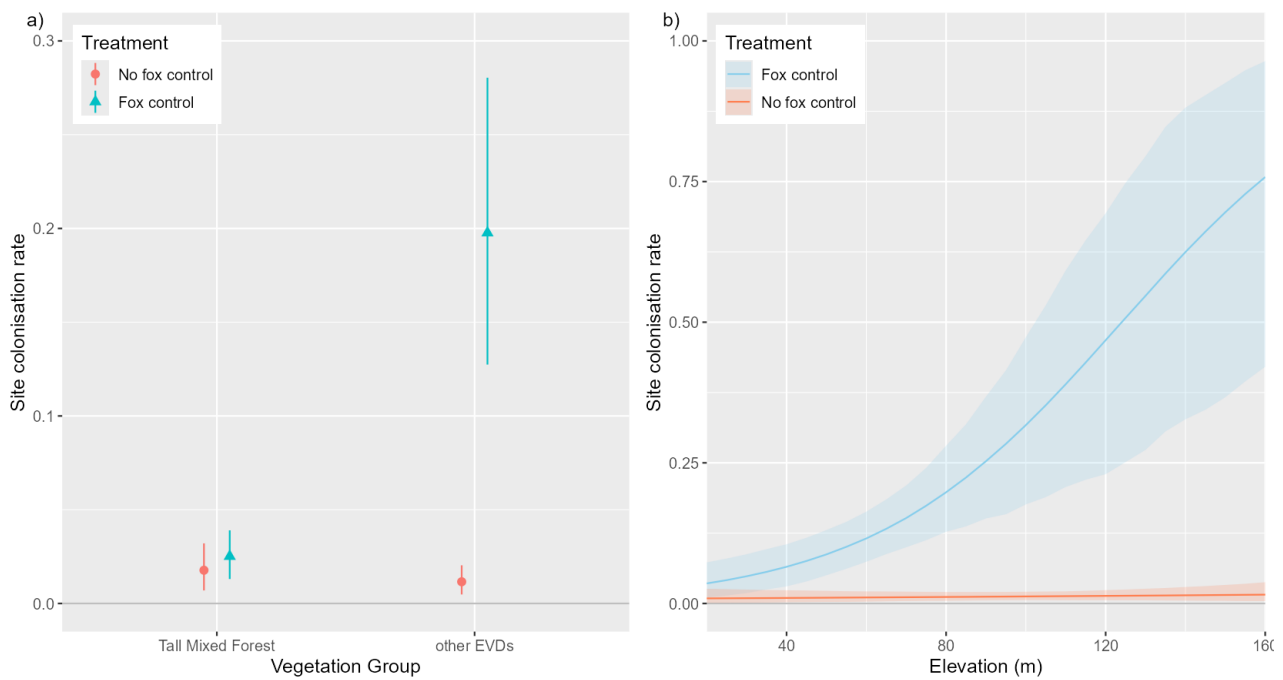


Figure 8. Estimated site colonisation rates (0-1) for the Long-nosed Potoroos in relation to a) vegetation group and b) elevation, by fox-control treatment, given all other covariates were held at their mean values.

The lines (blue – fox control, red – no fox control) indicate the median fitted values, and the shaded areas represent the 95% credible intervals.

Site growth rates

There was no substantial difference in average growth rate between FCMLs and NFCMLs (0.04%, 95% CI: 0.02–0.07%), with the annual growth rate in NFCMLs being 94% (95% CI: 91–97%) and the annual growth rate in FCMLs being 99% (95% CI: 96–101%). This effectively indicates that there has been no real change in the population growth rate of Long-nosed Potoroos from 2005 to 2025 in either FCMLs or NFCMLs.

3.1.3 Southern Brown Bandicoot

Occupancy

None of the modelled covariates influenced initial occupancy (pre-fox-control) rates (Table A5-A).

There is continued strong evidence since 2006 that the average occupancy rate for Southern Brown Bandicoots in FCMLs is greater than in NFCMLs (Figure 9). There has been a steady decline in occupancy since 2023; however, similar declines occurred from 2008–2011. There were multiple declines followed by a recovery in the ensuing years.

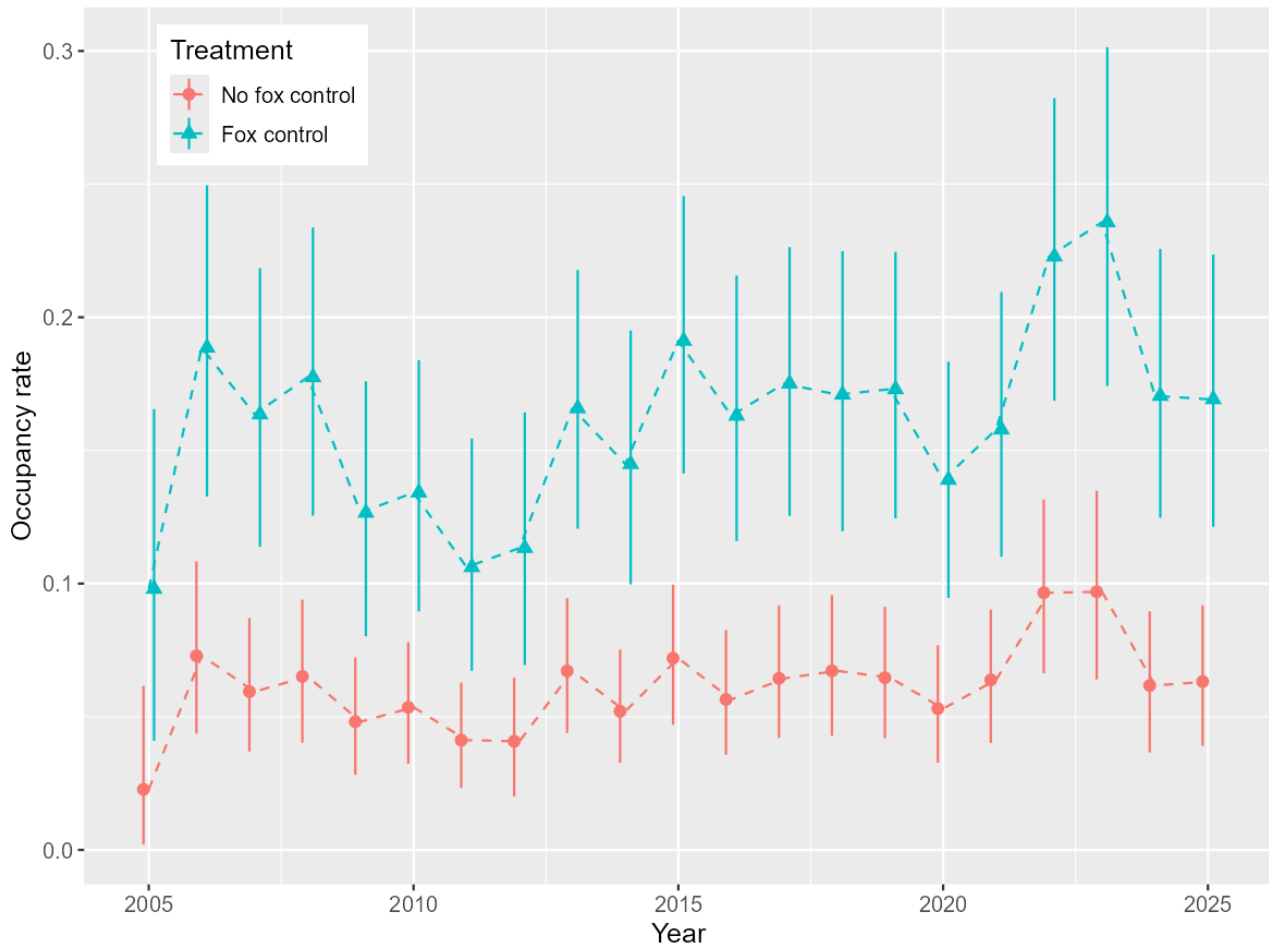


Figure 9. Occupancy rates (0-1) for the Southern Brown Bandicoot over time (2005–2025) by fox-control treatment.

The line is the median occupancy rate, and the vertical bars represent the 95% high density interval.

Site survival rate

As in previous years, the odds a site remained occupied was influenced by fox control, distance to water, elevation, and the time since last fire. Bandicoots tended to prefer to occupy sites with fox control that were closer to water at higher elevations, and relatively recently burnt.

When keeping all variables at their mean values, fox control had a positive effect on site survival rate by a factor of just over two (OR = 2.33, 95% CI: 0.84–7.07).

In FCMLs, site survival rate declined by 71% with each 500 m increase in distance from water (OR = 0.29, 95% CI: 0.11–0.73) but was higher by a factor of 2.5 with each 500 m decrease in distance from water compared to in NFCMLs (OR = 2.44, 95% CI: 1.03–6.09).

With every 50 m increase in elevation, site survival rate was higher by a factor of 4.75 (95% CI: 1.31–17.25) in FCMLs than in NFCMLs (Table A5-B; Figure 10).

Time since last fire was influential in site survival rate regardless of the presence of fox control. The odds a site remained occupied declined by 42% each year since the last fire.

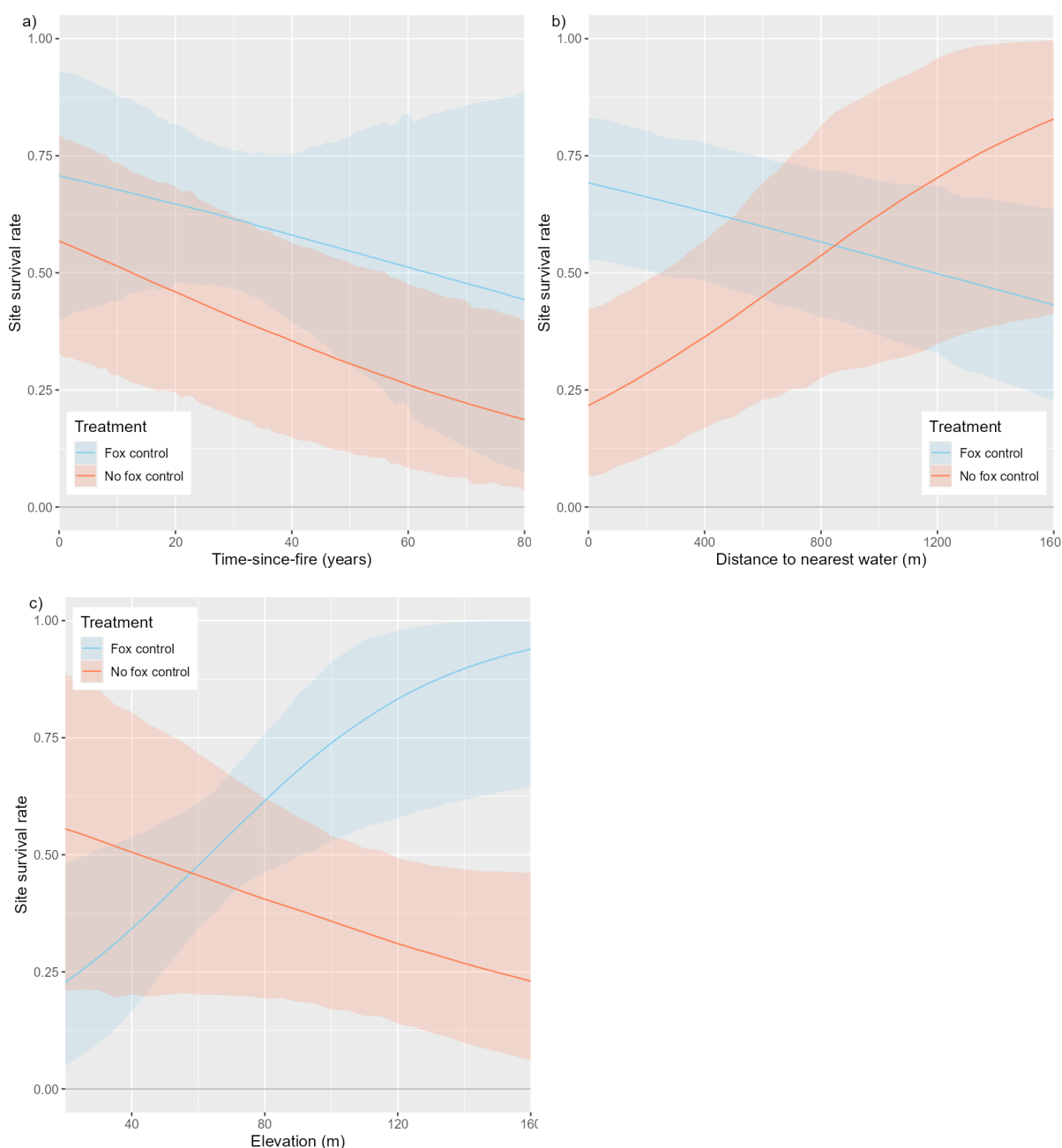


Figure 10. Site survival rate for the Southern Brown Bandicoot a) across different times-since-fire, b) distances to nearest water and c) elevations separated by fox-control status, given all other covariates were held at the mean values.

The line is the median fitted value, and the shaded areas represent the 95% high density interval.

Site colonisation rate

As in previous years, bandicoots tended to occupy previously unoccupied sites that were subject to fox control, away from non-native vegetation and that had been relatively recently burnt.

The odds of an unoccupied site becoming occupied were consistently greater in FCMLs than in NFCMLs, by a factor of just over three (OR: 3.17, 95% CI: 1.96–5.24).

Colonisation of sites was greater by 50% with each 1 km away from non-native vegetation (OR = 1.5, 95% CI: 1.23–1.82) compared to at sites without fox control, and decreased by 19% with each year since fire (OR = 0.81, 95% CI: 0.7–0.95) at sites with fox control compared to at sites without fox control (Table A5-C; Figure 11).

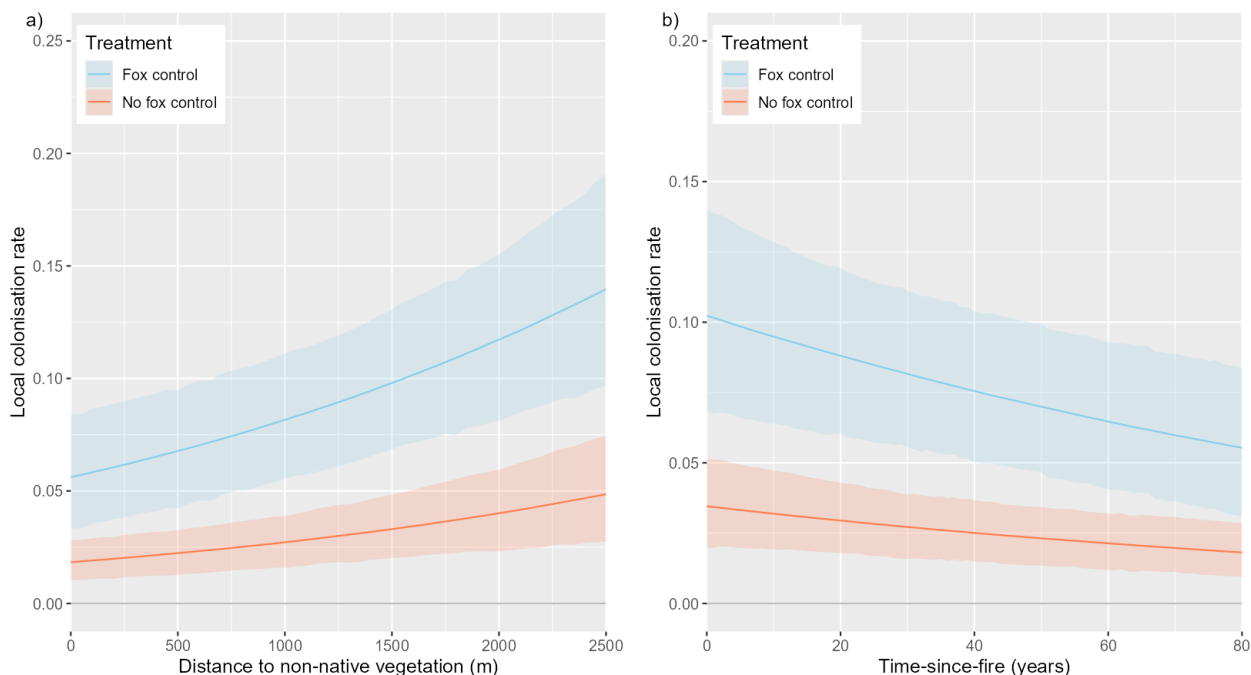


Figure 11. Estimated local colonisation rates (0-1) for the Southern Brown Bandicoot related to a) distance to non-native vegetation and b) time since last fire, separated by fox-control treatment.

Site growth rates

There was no substantial difference in average growth rate between FCMLS and NFCMLs (0.0%, 95% CI: -0.02–0.02%), with the annual growth rate in NFCMLs being 99% (95% CI: 96–102%) and the annual growth rate in FCMLs being 99% (95% CI: 97–102%). This effectively indicates that there has been no real change in the population growth rate of Southern Brown Bandicoots from 2005 to 2025 in either FCMLs or NFCMLs.

3.2 Detection rates (hair-tube and camera model)

Detection device influenced the estimated daily detection rate for each target species, although performance varied among species and no single device consistently provided the highest detection rates across all three species (Figure 12). The HC600 HYPFIRE had the highest daily detection rate for Common Brushtail Possums. For Long-nosed Potoroos, the HC500 HYPFIRE and HYPERFIRE HC PRO COVERT performed similarly well. Detection rates for Southern Brown Bandicoots varied little among camera models, although the PC900 COVERT PRO had the highest estimated rate.

Although hair-tubes had higher daily detection rates than any camera model, cameras had higher cumulative detection rates because they were deployed for substantially longer periods, typically about 30 days compared with four days for hair-tubes.

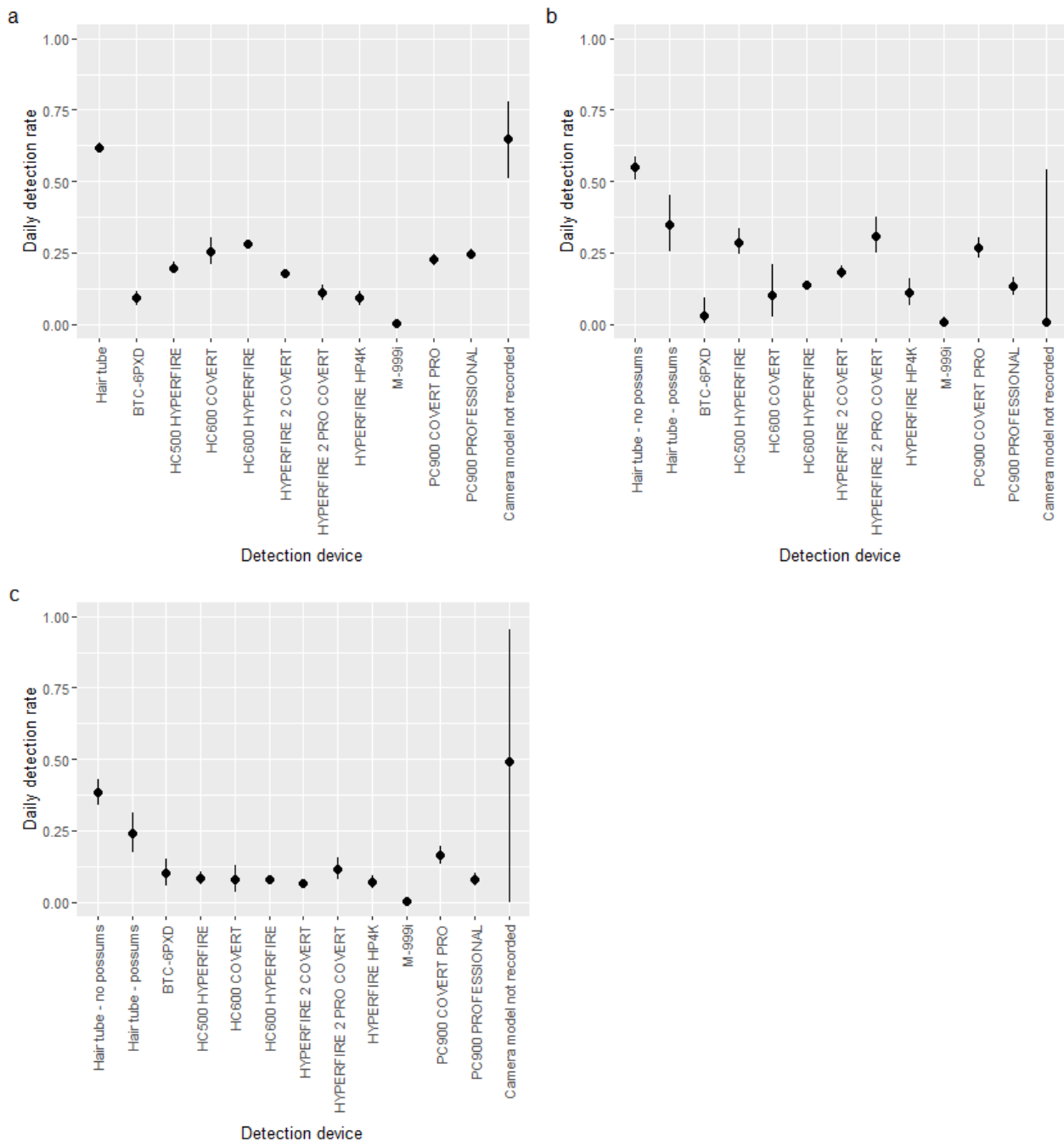


Figure 12. Daily detection rates of a) Common Brushtail Possums, b) Long-nosed Potoroos, and c) Southern Brown Bandicoots by detection device (hair-tubing and cameras).

3.3 Predator activity

3.3.1 Fox activity

The overall fox Activity Index in NFCMLs was greater than in FCMLs. Over the 13 years of camera trapping, foxes were never detected at 2.5% to 10% of sites within the FCMLs (Table 2). In contrast, foxes were detected at least once at every site at Hotspur and LGNP-north and nearly all sites at Annya.

Table 2. Summary of fox detections across all years by location.

Treatment	Location	% of sites foxes never detected	Total fox detections	Fox Activity Index
Fox control	Cobboboonee	2.5	334	25.5
Fox control	Mount Clay	5	295	22.2
Fox control	LGNP-south	10	184	13.8
No fox control	Annya	0	1420	108
No fox control	Hotspur	0	1067	78.4
No fox control	LGNP-north	0	1132	91.6

Fox activity in unbaited locations declined from 2013 to 2016, where it has plateaued. While in the baited locations the Activity Index is much lower, there may have been a small increase over the last few years (Figure 13).

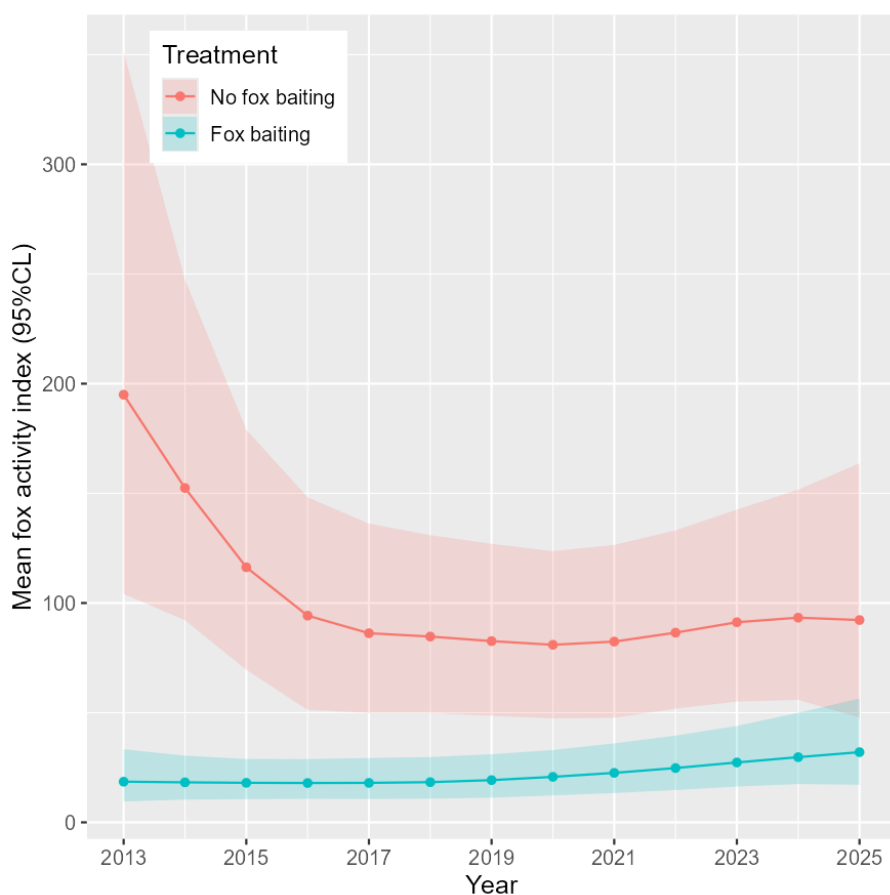


Figure 13. The mean modelled fox Activity Index by fox-control treatment over time.

The line is the median fitted value, and the shaded areas represent the 95% high density interval.

3.3.2 Feral cat activity

Over the 13 years of camera trapping, feral cats were never detected at fewer than 25% of sites outside of LGNP north and south. Rather, they were detected at least once at 97.5% (39 out of 40) of sites in the LGNP-north and 87.5% (35 out of 40) of sites in the LGNP-south (Table 3).

The feral cat models indicated a better fit for the independent location and year model; however, there was also some support for the location only model (Table A7). The best model showed that there was a difference between the locations, and that feral cat activity declined at locations over time until 2021, before increasing (Figure 14).

Table 3. Summary of feral cat detections across all years by location.

Treatment	Location	No feral cats detected (% of sites)	Total feral cat detections	Feral cat Activity Index
Fox control	Cobboboonee	22.5	116	8.3
Fox control	Mount Clay	45	74	5.15
Fox control	LGNP-south	12.5	209	14.7
No fox control	Annya	40	64	4.56
No fox control	Hotspur	25	111	7.66
No fox control	LGNP-north	2.5	224	17

The feral cat Activity index declined from 2013 to 2020, but since then has marginally increased across all locations. Activity varied by site, being consistently lower at Annya and Mt Clay relative the other locations, and highest at LGNP-North and south. There was no strong evidence of a treatment effect. In 2025, activity was still lower across locations than in 2013 at each location (Figure 14).

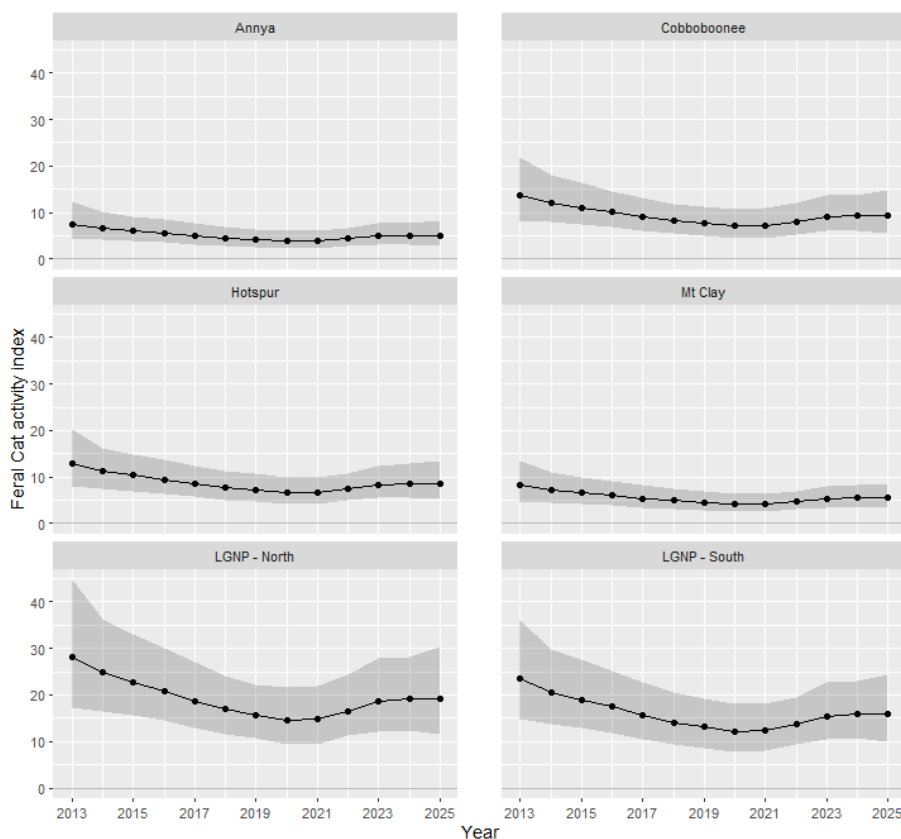


Figure 14. The mean modelled feral cat Activity Index by fox control treatment over time.

The line is the median fitted value, and the shaded areas represent the 95% high density interval.

3.4 Naïve occupancy of other species

Between 2013 and 2025, the camera trapping program detected 124 species across both the FCMLS and the NFCMLS. This included 76 bird species, 34 mammals (including 9 rodents and 7 introduced species), 7 reptiles and 1 monotreme.

Several species were detected intermittently during this time, and we present data only for those that were detected for at least 7 of the 13 years of camera trapping (Figure A1).

Black-tailed Wallabies (*Wallabia bicolor*) were consistently detected at most sites, with no difference between locations with and without fox baiting. In comparison, Red-necked Wallabies (*Notamacropus rufogriseus*) have steadily declined in site detection, decreasing from 75% of sites in 2013 to slightly over 50% in 2025, with similar trends observed in both FCMLS and NFCMLS.

Since 2013, Eastern Ring-tailed Possums (*Pseudocheirus peregrinus*) have steadily increased across FCMLS and NFCMLS.

Short-beaked Echidna (*Tachyglossus aculeatus*) were detected at more sites with no fox baiting, with this difference increasing over time.

Koalas (*Phascolarctos cinereus*) have remained steady and always more common across FCMLS.

Since 2013, Pied-Currawongs (*Strepera graculina*), Grey Shrike-thrush (*Colluricincla harmonica*) and Rufus Bristlebirds (*Dasyornis broadbenti*) have steadily increased in FCMLS and NFCMLS.

Fallow Deer (*Dama dama*) increased across both fox baited and unbaited locations, with higher rates of increase in FCMLS from 2022 onwards.

4 Conclusion

This year's update continues to show that long-term fox control at Glenelg Ark has been associated with higher occupancy of the three target native mammals—Common Brushtail Possum, Long-nosed Potoroo and Southern Brown Bandicoot—than in areas without fox control. Fox activity remains substantially lower in treated areas, and the results show that reduced fox predation has supported higher colonisation and survival for some species, particularly Long-nosed Potoroos and Southern Brown Bandicoots. However, growth in occupied sites has largely stabilised, indicating that recovery of these species is now also influenced by other factors.

The results show that habitat condition, vegetation type, fire history, water availability, elevation and predator interactions all influence species responses. Tall Mixed Forest appears important for possums and potoroos, while water availability, distance from non-native vegetation and time-since-fire affect bandicoot occupancy and persistence. Some relationships, such as the influence of elevation, remain unclear and would benefit from improved habitat and productivity measures, including more detailed site-level data and remotely sensed variables such as the fraction of absorbed photosynthetically active radiation (FAPAR).

Overall, the Glenelg Ark project demonstrates that sustained fox control can provide measurable benefits for native mammals, but these benefits are also influenced by broader ecological conditions. Feral cats remain a continuing threat and should be considered in future predator management. The program is one of the few long-term fox control projects in Australia with both treatment and non-treatment areas and ongoing monitoring of predators and native prey. This makes it a valuable example of adaptive management and provides an important evidence base for future conservation planning.

Recommendations

Here we provide some recommendations on possible next steps in the monitoring program.

1. Continue the current monitoring to improve the estimates and model predictions to better inform management.
2. Review the variables used in the modelling and update with both site-specific data and more accurate remotely sensed variables, e.g. FAPAR as a more informative measure of changes in productivity.
3. Improve the assessment of fox and feral cat densities across all sites, through (i) data derived from genetic material collected from scats, and/or (ii) the use of distance-sampling using data collected from camera traps.
4. Model fox occurrence in relation to environmental variables to determine whether foxes' habitat preferences interact with prey species responses.
5. Commence planning for the integration of feral cat control. A possible design for the rollout of feral cat control is provided in Robley et al. (2019). This approach would also continue to add to the current long-term monitoring dataset.
6. Investigate opportunities to assess the response in small mammals to fox control, particularly the Heath Mouse (*Pseudomys shortridgei*).
7. Include Short-beaked Echidna response in the 2026 data analysis.

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Appendix

Table A1. Ecological Vegetation Classes (EVCs) within each fox-control monitoring location (FCML) and no-fox-control monitoring location (NFCML).

Location	Ecological Vegetation Division (EVD)	Area (ha)	%	Ecological Vegetation Class (EVC)	Area (ha)	%
Mount Clay State Forest (fox control)	Other EVDs	1597	36.3	Heathy Woodland/Damp Heathland Mosaic	1597	35.6
	Tall Mixed Forest	2797	63.7	Herb-rich Foothill Forest	847	18.9
				Lowland Forest	1950	43.4
LGNP-south (fox control)	Tall Mixed Forest	1319	16.5	Damp Sands Herb-rich Woodland	1319	14.9
	Other EVDs	6654	83.5	Damp Sands Herb-rich Woodland/Heathy Woodland Mosaic	2855	32.2
				Damp Sands Herb-rich Woodland/Heathy Woodland/Sand Heathland Mosaic	972	11
				Heathy Woodland/Limestone Woodland Mosaic	2827	31.9
Cobboboonee National Park (fox control)	Tall Mixed Forest	7557	79.9	Lowland Forest	7557	79.9
	Other EVDs	1035	11.0	Wet Heathland/Heathy Woodland Mosaic	1035	11
Hotspur State Forest (no fox control)	Tall Mixed Forest	5332	91.5	Heathy Woodland	2235	32.9
	Other EVDs	493	8.5	Lowland Forest	3097	45.6
				Wet Heathland	493	7.3
LGNP-north (no fox control)	Tall Mixed Forest	2021	45.1	Damp Sands Herb-rich Woodland	2021	43.5
	Other EVDs	2458	54.9	Damp Sands Herb-rich Woodland/Heathy Woodland Mosaic	417	9
				Wet Heathland/Heathy Woodland Mosaic	2041	43.9
Annya State Forest (no fox control)	Tall Mixed Forest	6810	100.0	Damp Sands Herb-rich Woodland	1106	13.5
				Lowland Forest	5704	69.8

Table A2. Parameters and their definitions used in the multi-season occupancy model.

Parameter	Description
t	The survey period since the initial survey in 2005.
$Y_{i,t,j}$	Observation status of a species at site i in period t on the j observation: 1 (detected), 0 (otherwise).
$Z_{i,t}$	True occupancy status of a species at site i in period t : 1 (occupied), 0 (otherwise).
$\psi_{i,t}$	The occupancy rate for a species at site i in period t .
$p_{D,j}$	The daily detection rate of a species depending on the device D used on day j at a site, given the site is occupied.
$x_{i,t,h}$	Variable of interest h at site i in period t .
$\gamma_{i,t}$	Colonisation rate at site i in period t .
$\eta_{i,t}$	Survival rate at site i in period t .
$\varepsilon_{C,t}$	Random variation in colonisation rates in period t .
$\varepsilon_{S,t}$	Random variation in survival rates in period t .
σ_C	Standard deviation in the random variation in colonisation rates between periods.
σ_S	Standard deviation in the random variation in survival rates between periods.

Table A3. Parameter estimates (posterior median and 95% credible limits) and corresponding odds ratios for initial occupancy, local survival and colonisation for the Common Brushtail Possum.

Parameter	Median (95% CI)	Odds ratio (95% CI)	Interpretation
A: Initial occupancy (pre-control)			
Distance to water	-0.28 (-0.94, 0.31)	0.76 (0.39, 1.37)	No influence in initial occupancy as distance increases.
Tall Mixed Forest (Eastern)	0.72 (-0.86, 2.50)	2.06 (0.42, 12.19)	No influence of initial occupancy.
Distance to water in FCMLs	0.66 (-0.05, 1.46)	1.93 (0.95, 4.30)	No influence of initial occupancy.
Tall Mixed Forest (Eastern) in FCMLs	9.93 (1.05, 19.83)	20620 (2.8, 4.09E+08)	Highly uncertain positive relationship with initial occupancy and Tall Mixed Forest in fox control locations.
FCMLs	-6.58 (-13.22, -0.54)	1.39E-03 (1.82E-06, 0.58)	Highly uncertain influence on the odds a site would be occupied.
B: Site survival rate			
Distance to non-native vegetation in NFCLs	-0.507 (-0.82, -0.19)	0.60 (0.44, 0.84)	60% decline in site survival rate as distance increases.
Terrain Ruggedness Index	-0.068 (-0.32, 0.21)	0.93 (0.72, 1.23)	No influence on the probability a site remains occupied through time.
Tall Mixed Forest (Eastern)	0.604 (0.21, 1.01)	1.83 (1.24, 2.75)	An 83% increase in local survival in Tall Mixed Forest (Eastern) compared to in other EVDs.
Elevation	-0.333 (-0.59, -0.08)	0.72 (0.56, 0.93)	A 28% decline in local survival with every 40 m increase in elevation. Not statistically different.
Distance to non-native vegetation in FCMLs	0.607 (0.21, 1.02)	1.83 (1.24, 2.78)	83% increase in the odds a site survives compared to non-fox control areas for every 1 km closer to native vegetation.
Terrain Ruggedness Index in FCMLs	0.561 (0.06, 1.07)	1.75 (1.06, 2.91)	75% increase in the odds a site remains occupied.
Fox control area	0.157 (-0.205, 0.54)	1.17 (0.81, 1.72)	No influence on the probability a site remains occupied through time.
C: Site colonisation			
Terrain Ruggedness Index	0.065 (-0.141, 0.272)	1.07 (0.87, 1.31)	No influence on the probability a site becomes occupied through time.
Elevation	-0.277 (-0.49, -0.051)	0.76 (0.61, 0.95)	A 24% decline in the odds a site would be occupied with every 40 m increase in elevation.
Tall Mixed Forest (Eastern) in NFCMLs	-0.269 (-0.639, 0.093)	0.76 (0.53, 1.10)	No influence on the probability a site becomes occupied through time.
Terrain Ruggedness Index in FCMLs	0.357 (-0.082, 0.795)	1.43 (0.92, 2.21)	No influence on the probability a site becomes occupied through time.
Tall Mixed Forest (Eastern) in FCMLs	1.15 (0.574, 1.778)	3.15 (1.78, 5.92)	A 3.0-fold increase in the odds a site is colonised in Tall Mixed Forest compared to non-fox control sites.
FCMLs	-0.431 (-0.86, 0.003)	0.65 (0.42, 1.00)	No influence on the probability a site becomes occupied through time.

Bold type indicates evidence that the covariate was important. All estimates are on the logit scale. CI = credible interval.

Table A4. Parameter estimates (posterior median and 95% credible limits) and corresponding odds ratios for initial occupancy, local survival and colonisation for the Long-nosed Potoroo.

Parameter	Median (95% CI)	Odds ratio (95% CI)	Interpretation
A: Initial occupancy (pre-control)			
Tall Mixed Forest (Eastern)	0.837 (-0.78, 2.51)	2.31 (0.46, 12.34)	No relationship with sites in Tall Mixed Forest (Eastern).
Tall Mixed Forest (Eastern) in FCMLs	-7.301 (-10.00, -3.82)	0 (0, 0.02)	Highly uncertain relationship with EVD and fox control.
FCMLs	-5.575 (-19.24, 2.11)	0 (0, 8.27)	No relationship with fox control locations.
B: Local survival			
Distance to water	-0.87 (-1.78, -0.04)	0.42 (0.17, 0.96)	Local survival declines by 58% with every 500 m from water.
Topographic Wetness Index	0.75 (0.08, 1.51)	2.11 (1.08, 4.53)	With every 2 units of TWI there is a 2.11-fold increase in local survival.
Tall Mixed Forest (Eastern)	-1.18 (-2.784, 0.50)	0.31 (0.06, 1.65)	No relationship with Tall Mixed Forest (Eastern).
Time-since-fire	0.23 (-0.26, 0.72)	1.25 (0.77, 2.06)	No relationship with time-since-fire.
Distance to water in FCMLs	0.71 (-0.15, 1.63)	2.04 (0.86, 5.09)	Nearly two-fold increase with every 500 m from water <u>compared with in NFCMLs.</u>
Topographic Wetness Index in FCMLs	-0.41 (-1.20, 0.41)	0.66 (0.3, 1.51)	No relationship with TWI.
Tall Mixed Forest (Eastern) in FCMLs	-0.02 (-1.84, 1.77)	0.98 (0.16, 5.87)	No relationship with EVD.
Time-since-fire in FCMLs	-0.29 (-0.90, 0.32)	0.75 (0.4, 1.38)	No relationship with TSF.
FCMLs	0.90 (-0.10, 1.82)	2.47 (0.9, 6.2)	A nearly two-fold increase in local survival in FCMLs.
C: Local colonisation			
Elevation	0.16 (-0.43, 0.71)	1.17 (0.65, 2.04)	No relationship with change in elevation in NFCMLs.
Tall Mixed Forest (Eastern)	0.44 (-0.47, 1.36)	1.55 (0.63, 3.89)	No relationship with EVD in NFCMLs.
Tall Mixed Forest (Eastern) in FCMLs	1.112 (0.23, 1.98)	3.04 (1.26, 7.21)	A three-fold increase in the odds a site is colonised in other EVDs at fox control sites.
Elevation in FCMLs	-2.69 (-3.75, -1.57)	0.07 (0.02, 0.21)	93% decrease in the odds a site is colonised with each 50 m increase in elevation.
FCMLs	3.05 (2.33, 3.81)	21.2 (10.24, 45.11)	A 21-fold increase with fox control.

Bold type indicates evidence that the covariate was important. All estimates are on the logit scale. CI = credible interval.

Table A5. Parameter estimates (posterior median and 95% credible limits) and corresponding odds ratios for initial occupancy, local survival and colonisation for the Southern Brown Bandicoot.

Parameter	Median (95% CI)	Odds ratio (95% CI)	Interpretation
A: Initial occupancy (pre-control)			
Terrain Ruggedness Index	-4.92 (-9.18, -0.93)	0.01 (0, 0.39)	Uncertain slightly negative relationship.
Elevation	3.47 (-0.19, 7.27)	32.27 (0.83, 1433.68)	No relationship with elevation.
Terrain Ruggedness Index in FCMLs	5.70 (1.85, 10.00)	295.89 (6.37, 21872.82)	Highly uncertain positive relationship with TRI in FCMLs.
Elevation in FCMLs	-4.89 (-9.66, -0.72)	0.01 (0, 0.49)	Uncertain negative relationship with elevation in FCMLs.
FCMLs	2.36 (-14.40, 19.70)	10.64 (0, 3.56E+08)	No relationship with fox control locations.
B: Site survival rate			
Time-since-fire	-0.54 (-0.94, -0.16)	0.58 (0.39, 0.85)	Local survival declines by 42% with each year since fire.
Tall Mixed Forest (Eastern)	0.20 (-0.82, 1.26)	1.22 (0.44, 3.52)	No relationship with EVD.
Distance to water	0.89 (0.034, 1.81)	2.44 (1.03, 6.09)	A nearly 2.5-fold increase in the odds a site will persist with each 500 m closer to water compared to NFCMLs.
Elevation	-0.41 (-1.11, 0.22)	0.66 (0.33, 1.24)	No relationship with elevation.
Time-since-fire in FCMLs	0.20 (-0.30, 0.69)	1.22 (0.74, 2.00)	No relationship with TSF.
Tall Mixed Forest (Eastern) in FCMLs	-0.28 (-1.51, 0.95)	0.76 (0.22, 2.58)	No relationship with EVD in FCMLs.
Distance to water in FCMLs	-1.24 (-2.21, -0.32)	0.29 (0.11, 0.73)	71% decline in local survival with each 500 m increase in distance away from water.
Elevation in FCMLs	1.56 (0.27, 2.85)	4.75 (1.31, 17.25)	A nearly 5-fold increase in the odds a site would survive with every 50 m increase in elevation.
FCMLs	0.85 (-0.17, 1.96)	2.33 (0.84, 7.07)	Local survival was slightly more than a two-fold increase at fox control sites compared with at non-fox control sites.
C: Site colonisation			
Distance to non-native vegetation	0.40 (0.20, 0.60)	1.5 (1.23, 1.82)	50% increase in the odds a site is colonised with each km away from non-native vegetation.
Tall Mixed Forest (Eastern)	0.40 (-0.12, 0.20)	1.49 (0.88, 2.51)	No relationship with EVD.
Time-since-fire	-0.21 (-0.36, -0.05)	0.81 (0.7, 0.95)	19% decrease with each year since the last fire.
Tall Mixed Forest (Eastern) in FCMLs	-0.61 (-1.29, 0.09)	0.54 (0.27, 1.09)	No relationship with EVD in FCMLs.
FCMLs	1.15 (0.67, 1.66)	3.17 (1.96, 5.24)	Three-fold increase in the odds a site is colonised in FCMLs compared with in NFCMLs.

Table A6. Summary of the fox Activity Index model comparisons.

Model	Weight
Location + Year + Treatment:Year	0.720
s(Year) + Location	0.213
Null	0.067
Location + Year	0.000
Location	0.000
Location * Year	0.000

Table A7. Summary of the feral cat Activity Index model comparisons.

Model	Weight
Year + Location	0.785
Location	0.215
Location + Year	0.000
Location * Year	0.000
Location + Year + Treatment:Year	0.000

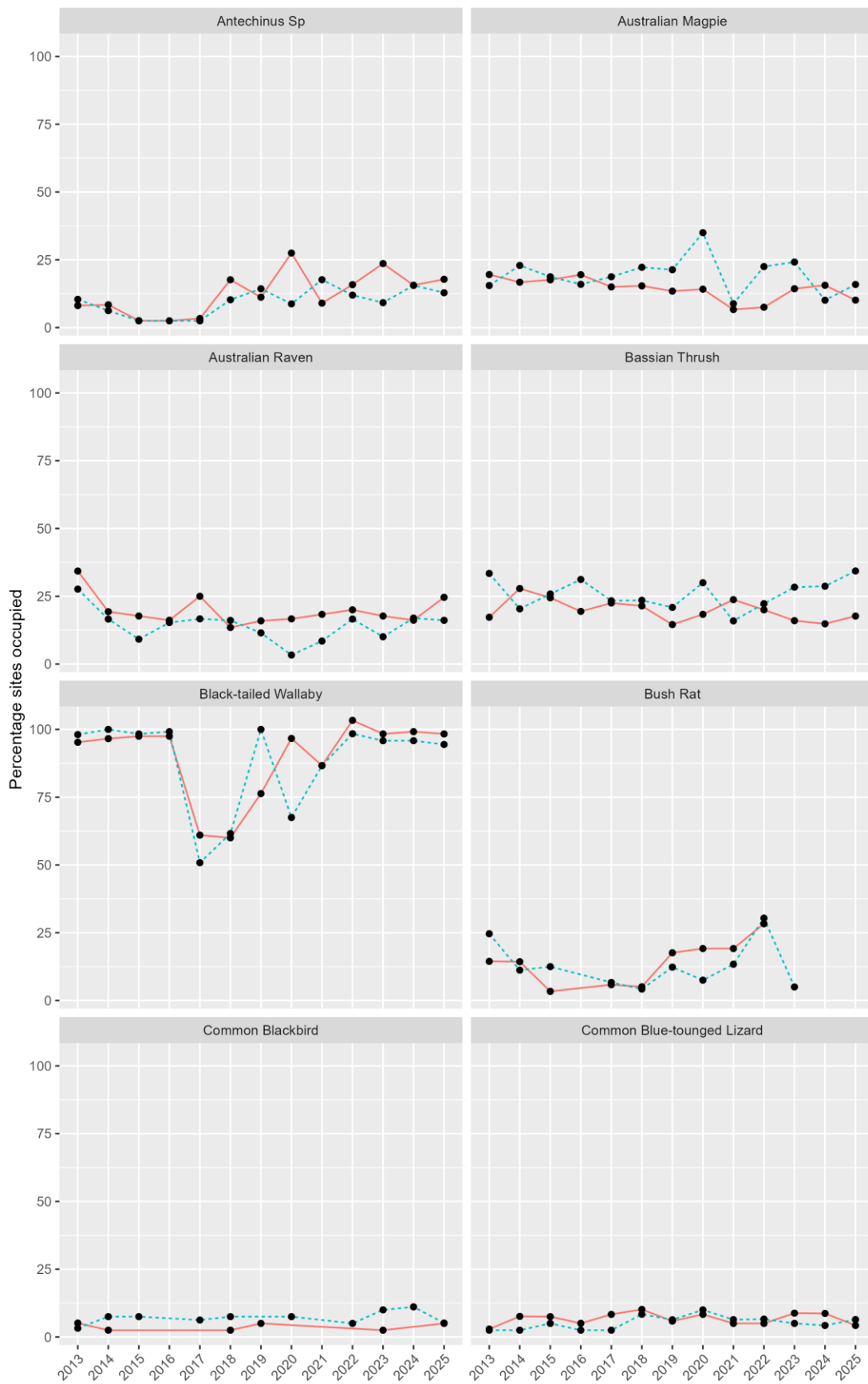


Figure A1. The average naïve occupancy (percentage of sites occupied) of native and introduced species in Glenelg Ark FCMLs and NFCMLs from 2013 to 2025.

Red solid lines: FCMLs; aqua dashed lines: NFCMLs.

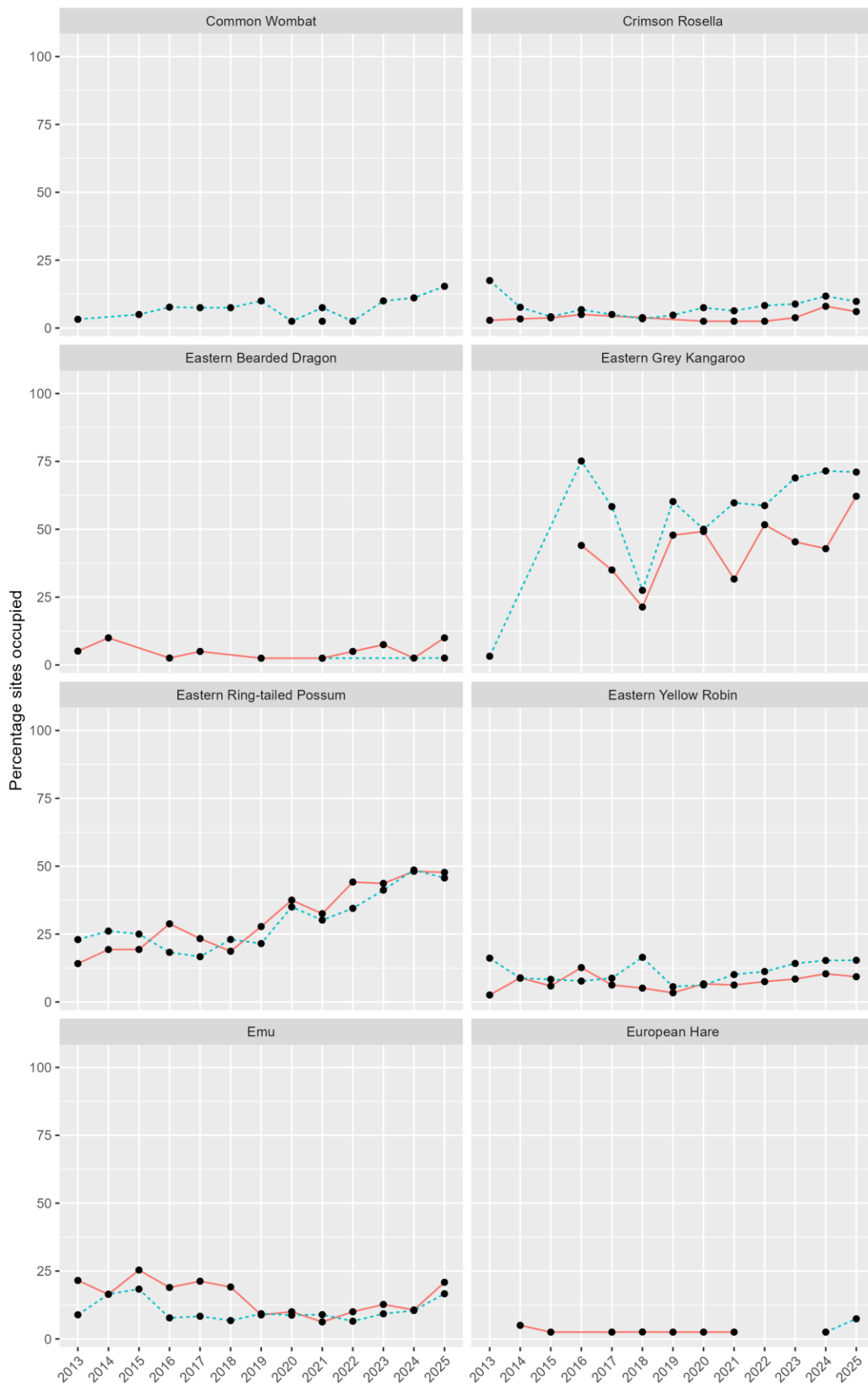


Figure A1 continued. The average naïve occupancy (percentage of sites occupied) of native and introduced species in Glenelg Ark FCMLs and NFCMLs from 2013 to 2025.

Red solid lines: FCMLs; aqua dashed lines: NFCMLs.

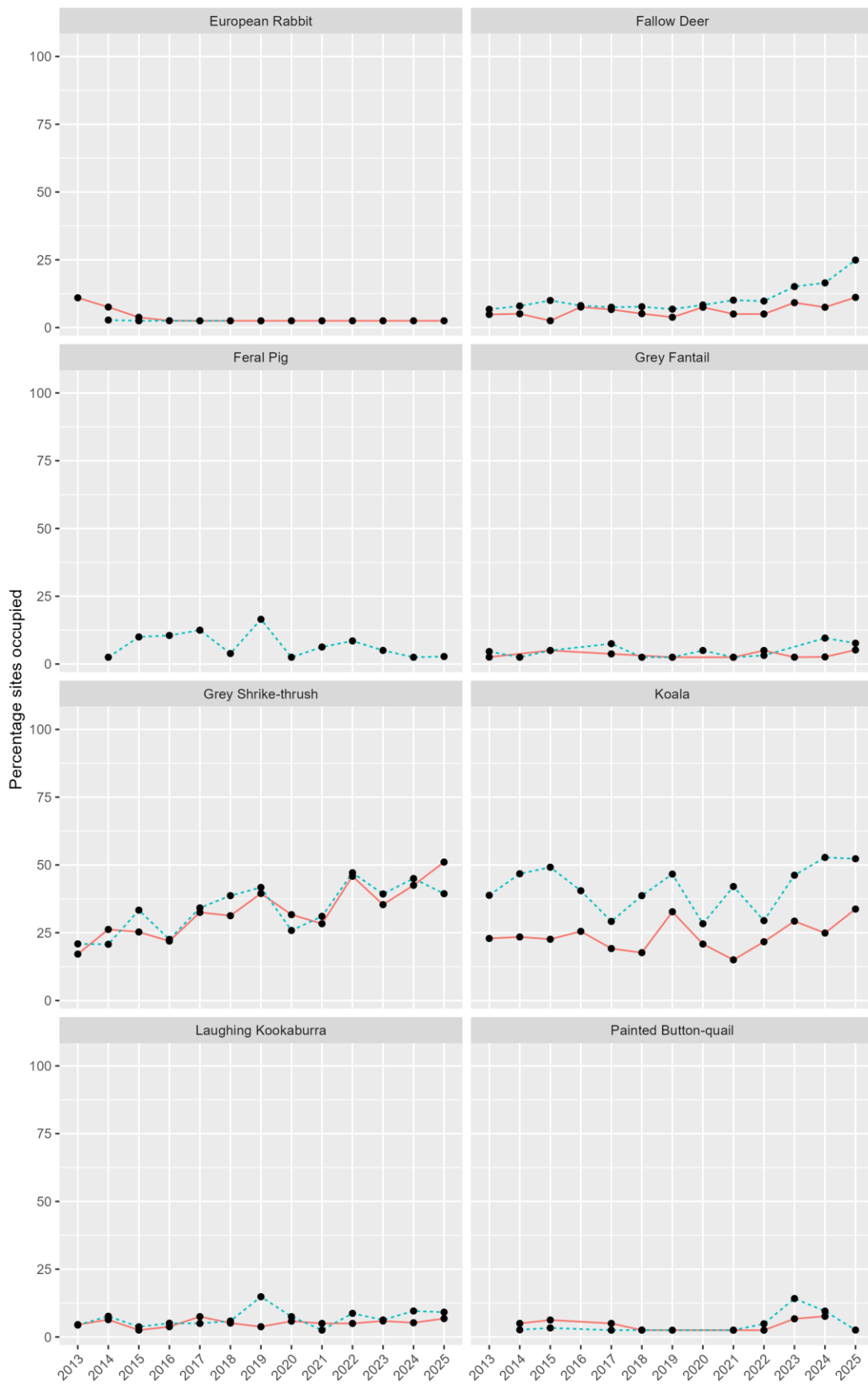


Figure A1 continued. The average naïve occupancy (percentage of sites occupied) of native and introduced species in Glenelg Ark FCMLs and NFCMLs from 2013 to 2025.

Red solid lines: FCMLs; aqua dashed lines: NFCMLs.

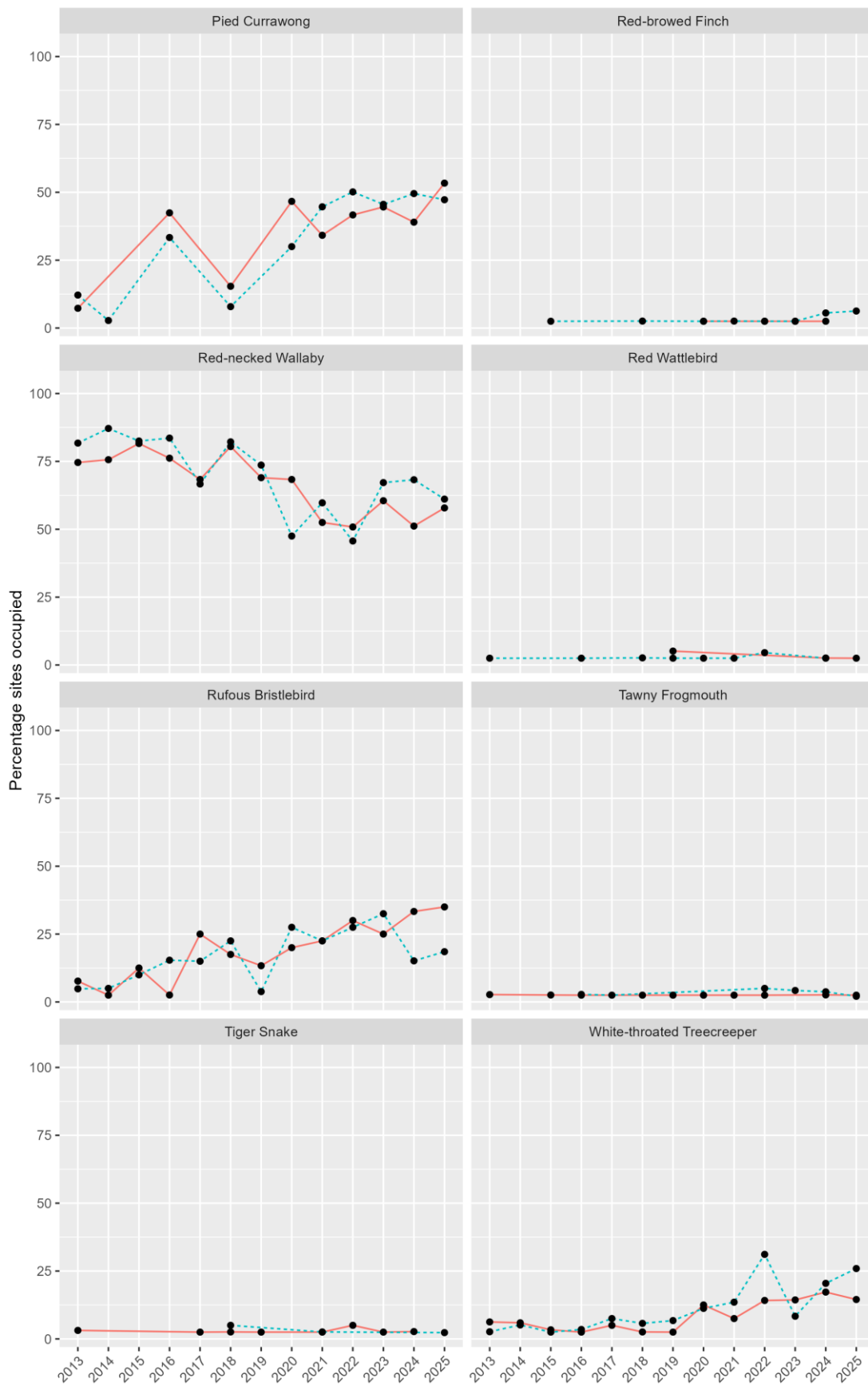


Figure A1 continued. The average naïve occupancy (percentage of sites occupied) of native and introduced species in Glenelg Ark FCMLs and NFCMLs from 2013 to 2025.
 Red solid lines: FCMLs; aqua dashed lines: NFCMLs.

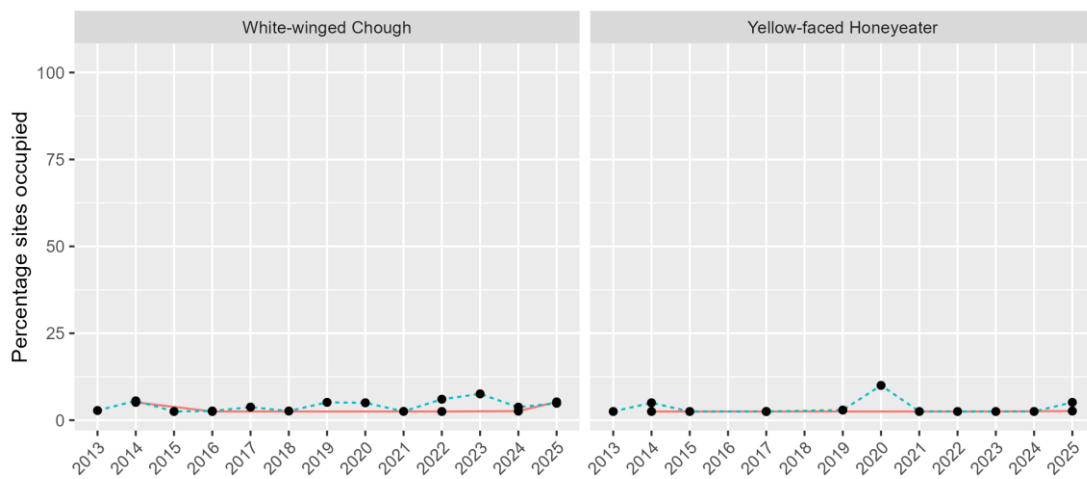


Figure A1 continued. The average naïve occupancy (percentage of sites occupied) of native and introduced species in Glenelg Ark FCMLs and NFCMLs from 2013 to 2025.

Red solid lines: FCMLs; aqua dashed lines: NFCMLs.

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