

# Using livestock guardian dogs to protect threatened species

## In brief

Populations of the Endangered eastern barred bandicoot (*Perameles gunnii*) have declined dramatically in Victoria largely due to predation by foxes. Maremma sheepdogs have been successfully used to protect livestock and penguins from fox predation. We set up trials to explore whether Maremmas may be useful in protecting translocated eastern barred bandicoots on farms without fox-exclusion fences.

Our results showed that in the presence of Maremmas, bandicoots were exposed to fewer foxes, and that foxes entering those spaces were less likely to engage in hunting behaviour and so would be less likely to prey on bandicoots. In the year before Maremmas arrived, foxes bred at the trial sites, but they did not breed on those sites after the Maremmas were introduced.

The separation of foxes and Maremmas appears mainly due to foxes avoiding areas occupied by Maremmas. Only two of the forty bandicoots released across two trial sites were confirmed to have died due to fox predation, though others have gone missing. The surviving bandicoots all maintained their weight, and several females have bred.

Monitoring at the experimental trial sites is ongoing and by next year we should be able to determine whether fox predation has been suppressed enough by the Maremmas to enable the establishment of viable bandicoot populations. This study provides information on a new method of conservation management that may be useful for other small native mammals.

## Background

The mainland population of the Endangered eastern barred bandicoot became extinct in the wild due primarily to fox predation and habitat loss. All existing populations in Victoria are descended from individuals collected for a captive breeding program established in the late 1980s. Given the difficulty of fox eradication, it has largely proven impossible to reintroduce bandicoots into their former habitats.

Protection of eastern barred bandicoots in the wild currently requires either complete exclusion of foxes by fencing, or establishment of the bandicoots on fox-free islands. If we are to restore the bandicoots to large parts of their original range, new approaches are required to prevent them from being killed by foxes in open landscapes on the mainland.

We tested whether livestock guardian dogs—Maremma sheepdogs—could help solve this problem. Maremmas currently protect penguins from fox incursions on Middle Island, south of Warrnambool in Victoria. Sheep are very rarely attacked by foxes when accompanied by Maremmas.



Maremma dog with sheep at one of the farms.  
Image: Zoos Victoria

## Background (continued)

This protective effect of Maremmas has been observed in habitats similar to those where eastern barred bandicoots occurred. We believe that the presence of Maremmas could create safe spaces, providing incidental protection for bandicoots living in sheep-farms. If this proves true, safe spaces could be created without the need for exclusion fencing or intensive fox control, offering a new model for the conservation of threatened wildlife.



Eastern barred bandicoots being released.  
Image: Zoos Victoria

## Research aims

We first aimed to understand the effects of Maremmas on fox movements and hunting behaviour. Second, we aimed to determine whether Maremmas provided a strong enough protective effect such that eastern barred bandicoots could persist in unfenced areas occupied by these livestock guardian dogs.

## What we did

This study was a collaboration between researchers from Zoos Victoria and the Universities of Tasmania and Melbourne, in liaison with the eastern barred bandicoot recovery team, and in partnership with a range of landowners and managers in Victoria. Research was undertaken in Victoria, on two sets of properties:

1. two large sheep farms (Riversdale and Heatherlie) where Maremmas were already well established for sheep protection; and
2. two separate farms (Mooramong and Dunkeld), where we ran experimental trials measuring changes in fox activity following the introduction of Maremmas and sheep flocks.

We studied the effect of Maremmas on the distribution and behaviour of foxes in the established sheep farms. Then we released 20 bandicoots into each of the two experimental sites, following the introduction of Maremmas and sheep flocks to these areas. Bandicoots were sourced from the captive breeding program and several fenced, wild populations (Churchill Island, Hamilton Community Parkland). We concentrated the bandicoot releases in the parts of the trial sites that were most consistently

used by Maremmas, because fox detections were rarest in those areas. We conducted the initial release in November 2020 and the second in June 2021.

We measured the Maremmas' movements using GPS collars, and the activity of foxes using remote cameras within and outside the areas used by Maremmas. Bandicoot survival, health and breeding were monitored using a combination of radio tracking, remote cameras and microchip readers, and trapping surveys.

In addition, on the established sheep farms, we investigated the responses of Maremmas to the perceived presence of foxes using audio playback of fox calls, and the hunting behaviour of foxes in the presence of Maremmas. We tested hunting behaviour by burying food in locations with different levels of Maremma occupancy, and in similar areas without Maremmas. The food was buried at various depths and cameras were used to detect the length of time foxes spent digging for food. We hypothesised that if a fox was in an area used by Maremmas, it would respond to the risk of encountering a Maremma by limiting the amount of time spent at that place, even at the cost of forgoing the opportunity to collect food.



Eastern barred bandicoot at Werribee Zoo, Victoria.  
Image: Zoos Victoria

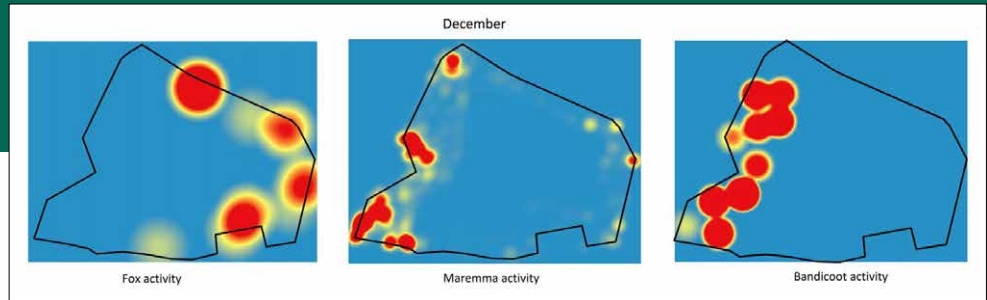


## Key findings

At both experimental trial sites fox activity declined substantially after Maremmas were introduced. Fox activity did not change on nearby control sites without Maremmas. Foxes almost completely avoided locations that were used regularly by Maremmas but were occasionally detected in parts of the sites that were visited rarely by Maremmas. This can be seen by the heat maps in Figure 1, which indicate where the different animals occurred. In the year before Maremmas arrived, foxes bred at the trial sites, but they did not breed there after the Maremmas were introduced. Foxes from surrounding areas occasionally visited trial sites after the Maremmas were introduced, but from that time we had no more resident foxes.

At the two sheep farms with established Maremmas, fox activity was reduced in the areas that Maremmas frequented. However, the separation of foxes and Maremmas was not as strong as it was at the trial sites. This is possibly because Maremmas ranged over larger areas of several hundred hectares at these farms, compared to around 60 hectares for the trial sites. This could have allowed foxes to safely maintain some overlap with Maremmas across the larger area.

We sometimes observed Maremmas chasing foxes but recorded no actual attacks. It seemed that the separation of foxes and Maremmas was mainly due to foxes avoiding Maremmas. This avoidance behaviour was reinforced by the threat of aggression on the occasions that foxes did encounter Maremmas. Experiments using audio playback of fox calls showed that Maremmas moved quickly to challenge intruding foxes and would probably attack them if they remained in the area.



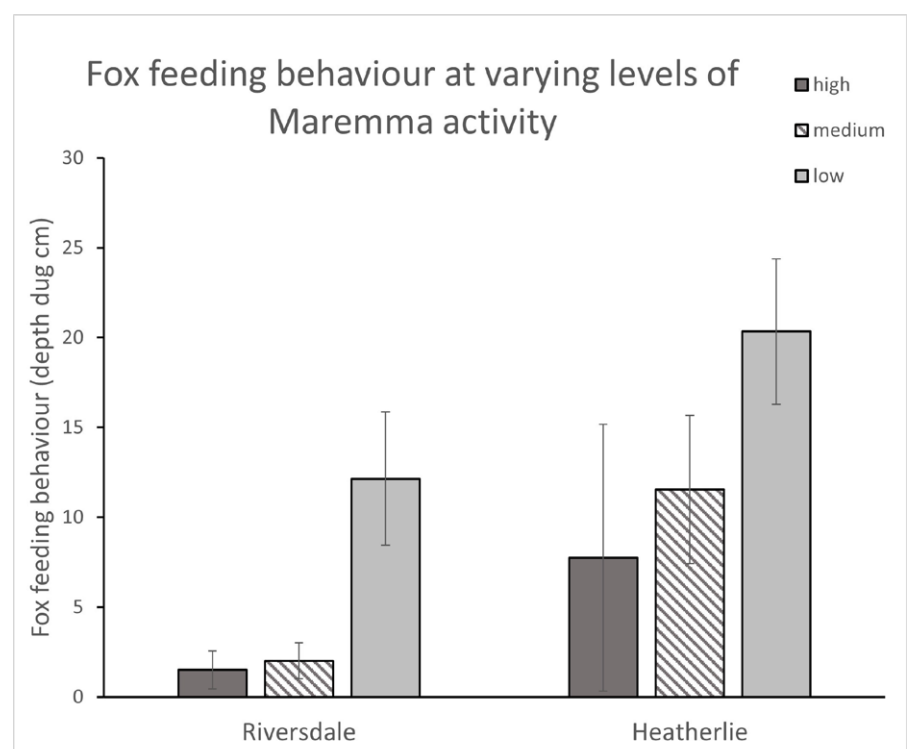
**Figure 1:** “Heat maps” showing the activity of foxes, Maremmas and eastern barred bandicoots (EBB) at the Mooramong trial site. Note that colour shades indicate relative activities for that species.

The partial overlap of foxes and Maremmas at the two large farms allowed us to analyse shifts in the behaviour of foxes in relation to overlap with Maremmas. Our results showed that foxes spent less time foraging in locations where Maremma activity was higher. Although foxes detected feed stations in places used frequently by Maremmas, they were less likely to remain there to dig out all food items (Figure 2). Interestingly, fox foraging was never directly interrupted by the arrival of a Maremma. Our results suggest that the behaviour of foxes instead changed according to whether they perceived themselves to be at risk, making them less likely to begin or to continue foraging.

At the farms where bandicoots were released, the bandicoots

generally remained close to their point of release, such that they stayed in areas consistently used by Maremmas and did not stray into areas where foxes were detected (Figure 1). Trial sites are bounded by a bandicoot-proof fence, so none could leave the area.

Several bandicoots died soon after release and others have gone missing, but only two deaths were confirmed as being due to fox predation. The surviving bandicoots have all maintained weight, and several females have bred. As of September 2021, bandicoots remained on both release sites, but it will be some time before we can determine whether fox predation has been suppressed sufficiently to enable the establishment and long-term persistence of bandicoot populations.



**Figure 2:** The relationship between the activity of Maremmas and the intensity of foraging by foxes who visit locations with buried food.



## Implications

This project focused on the potential for Maremmas to protect eastern barred bandicoots, but the results are also relevant to many other species of ground-dwelling native wildlife threatened by invasive predators.

Our findings are significant for recovery teams and others responsible for managing small mammals that are threatened by foxes, and for conservation land managers who wish to reduce the general impacts of foxes on threatened wildlife. This study will be important to farmers wishing to increase the abundance and diversity of wildlife on their properties while also maintaining their productive capacity for livestock.

This approach neatly combines the interests of wildlife conservation and farm productivity. Maremmas are already recognised as playing a valuable role on farms, because they increase the survival and welfare of livestock in situations where livestock are exposed to the risk of wild predators like foxes, dingoes and wild dogs. This value outweighs the expense and effort required for management of the dogs. While benefitting livestock, Maremmas could simultaneously increase the value of biodiversity conservation strategies on farms, such as retention or restoration of patches of native vegetation embedded in farm landscapes, by reducing the impacts of invasive predators on wildlife on farms.

This study provides a new understanding of how Maremmas give protection to livestock. Many people assumed that Maremmas protect sheep by counter-attacking predators, causing suffering and distress both to the predators and the Maremmas themselves. Our results show that while Maremmas do chase predators, and may attack them, the main way in which they protect stock is by causing avoidance and behaviour change in those predators. This knowledge will increase the acceptability of use of Maremmas as a humane method of pest control, and lead to improved management by farmers.

## Cited material

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## Further Information

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