33. Feral goat removal to restore habitat quality within Malleefowl nesting areas in the rangelands of New South Wales

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Abstract

Feral predators have been continuously cited over the last decade as one of the primary causes for the decline of Malleefowl, but limited research has been conducted to investigate the role of habitat degradation by the increasing threat of feral grazing. Baseline monitoring of vegetation condition during 2011-13 found that within the rangelands of western New South Wales there were no sites unaffected by goat *Capra hircus* browsing and grazing. Impacts are significant with goat exclusion sites having double the number of plant shrub species and three times more ground cover ($p = 0.0001$, $n = 20$). Lower plant species diversity and ground cover possibly reduces foraging availability and choice for Malleefowl. The reduction of ground cover may negatively influence Malleefowl survivorship from fox and cat predation. Goats have created a difficult dilemma in balancing conservation outcomes and maintaining income for landholders. In addition to installing a network of 56 water point goat traps, we have developed a landscape scale fencing method of passively removing feral goats from critical Malleefowl breeding habitat. In the long-term this new innovative use of strategic fencing to create a system of controlled traffic will reduce the impact of goat grazing in habitats of high conservation value. Simultaneously landholder costs will be reduced, making goats profitable under most financial situations. In the first year of total goat exclusion we have observed an increase of 20% (two new pairs) Malleefowl nesting activity. A neighbouring paired control without goat exclusion suffered a 50% decline (three less pairs).

Introduction

The decline of Malleefowl in western New South Wales has been attributed to a variety of factors and although this species is listed nationally as Vulnerable under the *Environment Protection and Biodiversity Conservation (EPBC) Act* 1999, within New South Wales Malleefowl are recognised as Endangered under the *Threatened Species Conservation Act* 1995. There are at least four primary threats and one potential threat that have been identified as the causes behind the decline of the Malleefowl (Benshemesh 2007). These threats begin with clearing and fragmentation of habitat for the purpose of agriculture primarily concerning wheat and sheep production but also more recently for the harvest of broombush (*Melaleuca uncinata*). Fire has also been listed as a primary threat because of its potential to destroy vast areas of mallee habitat in single events that can then take 30 to 60 years to recover to a state suitable for Malleefowl. The third threat is that of grazing by both feral and native species such as goats, sheep, rabbits and kangaroos. The latter species have in recent decades increased in numbers because of increased agricultural watering points but in addition to natural grazers there are now vast numbers of feral grazers living within Malleefowl habitat. These species directly compete for foraging resources as well as changing habitat structure through selective browsing. The final current threat is predation and has been well documented as a serious cause in the decline of the Malleefowl (Priddel and Wheeler 1997, 2009). Foxes have been the major species considered as a threat but there is also concern regarding increasing cat numbers. Climate change is now recognised as a potential threat to the future recovery of Malleefowl in New South Wales. Resultant shifts in rainfall patterns and temperature changes are predicted to lead to substantial declines in Malleefowl populations across their current range and will require adaptive management as the shifts manifest.

Methods

In July 2010 as part of an ongoing landscape scale vegetation monitoring project an area of land was selected 65km north of Hillston (55 H 401546 6330022) to begin a goat exclusion fencing trial. The site was 18km x 9km (16,000 hectares) in size, privately owned and without managed grazing stock. Grazing on the property consisted of uncontrolled feral goats, fallow deer and pigs. The area was divided into a northern and southern section for the purpose of ongoing replicate vegetation monitoring where only the northern section would be fenced to exclude goats re-entering the site following their removal. Fencing in the exclusion area was completed in October 2011 (Figure 1) and consisted of 120cm high ring-lock wire netting with two strands of barbed wire along the top and one along the bottom at ground level (addition of barbed wire was at property owner's cost and negotiation). At intervals of about 300m, a one-way gate was constructed allowing exit of goats from the area. There were no ground water sources within either sites, so goats voluntarily exited in their search for water (daily requirement) without the need for costly stock mustering or disturbance of Malleefowl.

Figure 1. Goat fence and one-way gate.

In each of the northern (site A) and southern (site B) areas, 20 permanent vegetation monitoring sites were placed and data collected in November 2011, 2012 and 2013. Each monitoring site consisted of a 50m transect, where data was collected for each $1m^2$ area along the length of the transect (total data collection area = 50 m^2). In each quadrat we recorded total plant species present, number of each plant species, average height of each plant species, vegetative state for each species (flowering, seeding, dormant, developing leaf buds), litter ground cover, percentage live vegetative cover and percentage overhanging canopy vegetation. This report only provides discussion regarding total percentage live vegetative cover and plant species diversity. Percentage live vegetative cover was defined as the total live vegetative cover, excluding tree canopy over-hang of the combined plant species for each quadrat. In general vegetation within the study area was characterised as mallee woodland with a canopy height of 3-5m and a sparse shrub layer averaging 1m in height. The dominant tree species were *Eucalyptus socialis* and the most common shrub species were *Melaleuca uncinata, Acacia colletioides, Vittadinia sulcata, Olearia pimelioides, Eremophila glabra* and *Bossiaea walker*.

Results

Comparing vegetation between sites A and B prior to the removal of goats indicated that there were no significant differences in either plant species diversity ($t_{38} = 0.31$, $p < 0.76$) (Figure 2) or plant ground cover ($t_{38} = 0.14$, $p < 0.89$) (Figure 3). Repeated assessment of the sites two years after goat removal indicated highly significant increases in both plant diversity ($t_{38} = -8.98$, $p < 0.0001$) and live vegetative cover ($t_{38} = -6.57$, $p < 0.0001$) within the area of goat exclusion. Repeated assessment of the sites where goats had not been removed indicated no significant differences in either of the vegetation measures between years (plant species diversity $t_{38} = -0.37$, $p < 0.71$) (live vegetative cover $t_{38} = -0.28$, $p < 0.78$).

Although the data collected for this paper was not designed to measure the breeding response of Malleefowl with the removal of grazing by goats there was an increase in the number of pairs nesting within the exclusion area. In the first year of total goat exclusion we observed an increase of 20% (two new pairs) nesting activity. A neighbouring paired control without goat exclusion suffered a 50% decline (three less pairs). Due to the low sample size of only one treatment and one control we were not able to test this result and cannot conclude significance.

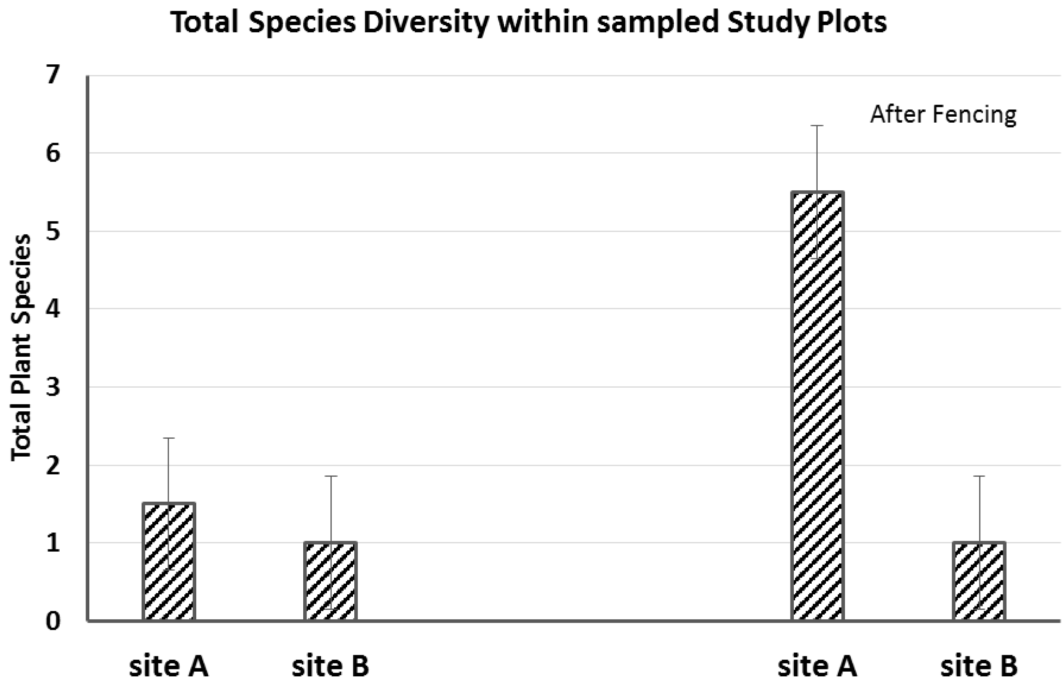

Figure 2. Comparisons of plant species diversity before and after fencing to exclude goats. Site A was fenced, site B remained as a control throughout the project without fencing.

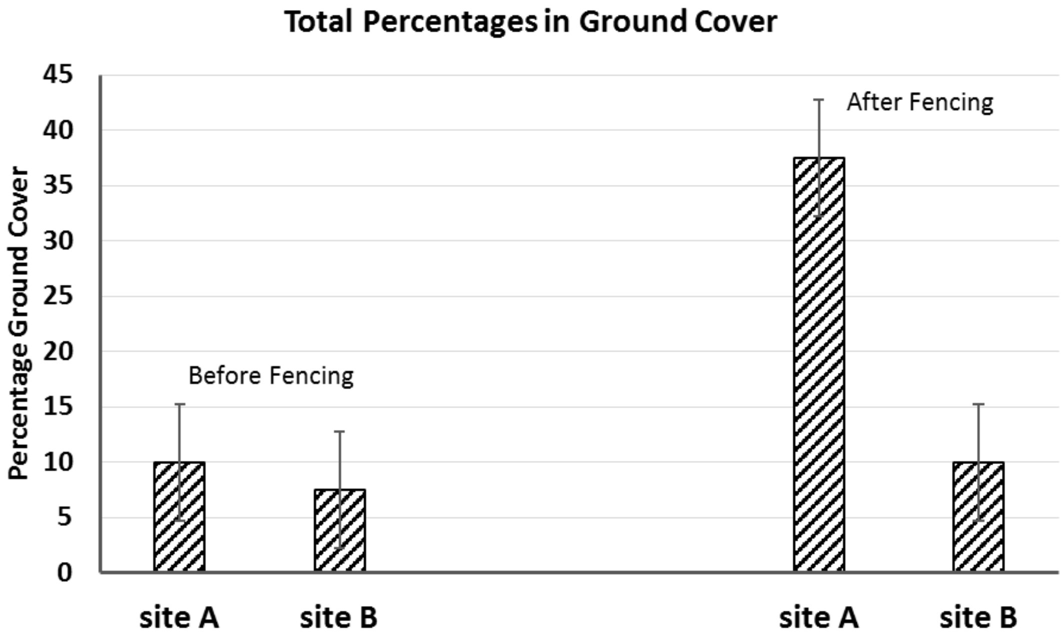

Figure 3. Comparisons of ground cover before and after fencing to exclude goats. Site A was fenced, site B remained as a control throughout the project without fencing.

Discussion

This study has shown that the loss of plant diversity and shrub layer vegetative cover in the mallee woodlands as a direct result of feral goat grazing is highly significant. Unfortunately this appears to be poorly recognised by rangelands managers as a threat to either the quality of vegetation communities or the faunal communities depending upon this vegetation. In the situation of the Malleefowl the degrading of vegetation in any form could have negative effects on several critical stages of this species' life history.

A reduction in plant species diversity could lead to a reduction in food resources. Seeds from native shrubs and grasses probably form a substantial component in the diet of Malleefowl. Different plant species vary in the seasonality of flowering and thus seed production. In an environment not modified by feral grazing there would be a wide choice of seed and its time of availability but in the current woodland system as many as two thirds of the plant species are either missing or significantly reduced in density. Reductions such as this leave restrictive periods in the year where nutrition is so reduced that it may limit the survival of some individuals that are either poor foragers or dispersers, such as young birds. Territory quality may also be reduced leading to pairs expanding the size of the area they defend. This will push some individual birds out of areas that in the past have supported higher population densities and into poorer vegetation types that may not support breeding and even limit survival.

It is interesting to note that Priddel and Wheeler (2009) concluded that food within the Yathong Nature Reserve was not a limiting factor in the survival of young Malleefowl. However, reviewing the data (Priddel and Wheeler 1997) from which they made their conclusions suggests that the evidence may have been limited by both sample size and the time period / extent of observations. Their conclusions were based upon two lines of reasoning: released surviving Malleefowl weight gain and vegetation sampling for abundance of Malleefowl food items. In the first instance although the authors reported significant weight gains in their surviving birds this appears to be skewed by three of the 12 birds released. These birds nearly doubled their mass, whereas many of the other birds made almost inconsequential gains. For instance in the first four birds that only survived 16 days, three of these lost weight. In the next group of two survivors, one bird (increased by 503g after 18 days) was one of the three outliers but the other bird only gained 126g.

A similar story can be seen throughout this data with many of the birds only gaining a very small amount of weight and there are no base-lines to compare the information with how much weight gain should be expected if food is in the appropriate abundance prior to grazing by goats. The poor survival rate of these birds may not have been solely the consequence of fox predation but may have been confounded by the birds being in very poor body condition and easily caught by foxes.

The second line of reasoning by Priddel and Wheeler (2009) is based upon evidence from previous work (Harlen and Priddel 1996) examining the abundance of seeds, ground-dwelling invertebrates and leaf buds over time in mallee vegetation. This is perfectly reasonable except the evidence for what constitutes the diet of a Malleefowl is perhaps a little generalised and lacking seasonal detail. Frith (1962) and Booth (1986) describe the Malleefowl as opportunistic herbivorous foragers and although other authors have added subsequent information there appears to have been limited detailed long-term observations (Brickhill 1987, Benshemesh 1992 (in Priddel and Wheeler 1997), Kentish and Westbrooke 1993). We have seen in other endangered species such as the Gouldian Finch that detailed knowledge of seed availability is vital in restoring the health and survivorship of a population (Lewis 2007). Within the time frame between the conclusions by Priddel and Wheeler (2009) and the work presented in this paper there has also been a substantial increase in goat population numbers (personal communications with landholders). Currently there are now thousands of goats being trapped within the mallee woodlands of western New South Wales and landholders do not believe there has been a significant reduction in numbers even with more efficient control measures.

Goats and, to a lesser extent, feral pigs and fallow deer, which all occur within the Malleefowl nesting sites of this study cause added disturbance that in general has gained little recognition. All of these species frequently visit active nests, using them for dust bathing and often mark nests with urine. Surveillance cameras have recorded hundreds of visitations during single breeding seasons but at this stage we have not been able to assess the damage caused by disturbance to the nest, eggs or the nest attendance of the Malleefowl. We have not recorded any of these feral species eating eggs or chicks.

The impact of loss of vegetation cover on survival of young Malleefowl was explored in previous work but found that the density of cover had no significant effects (Priddel, Wheeler and Copely 2007). Although this is a counterintuitive finding, the main vertebrate predators in this system are foxes and cats which are highly efficient and naïve nestlings are probably easily found and caught. In our study area, despite thrice yearly baiting by New South Wales National Parks and Wildlife Service our nest camera surveillance detected both predator species on all nests at least twice per week. Given that finding we would probably conclude that the major impact of goat grazing upon Malleefowl survival is more likely to be via the pathway previously described as reduction in food availability rather than vegetative cover. However there may still be cases where density of vegetation may succeed in enhancing the survival of some individual birds even though this may be a very low percentage.

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References

Benshemesh J. (1992) The conservation ecology of the Malleefowl, with particular regard to fire. Ph.D. Thesis, Monash University, Melbourne.

Benshemesh J. (2007) Advice to Natural Resource Management Bodies Regarding Management and Monitoring of Malleefowl. Report commissioned by the Mallee CMA and multi-regional "National Malleefowl Monitoring, Population Assessment and Conservation Action Project" steering committee.

Brickhill J. (1987) The conservation status of Malleefowl in New South Wales. Master of Natural Resources Thesis. University of New England, Armidale, NSW.

Booth D.T. (1986) Crop and gizzard contents of two mallee fowl. *Emu* **86,** 51-53.

Frith H. J. (1962) Conservation of the mallee-fowl, *Leipoa ocellata* Gould (Megapodiidae). *CSIRO Wildlife Research* **7**, 33–49.

Harlen R. and Priddel D. (1996) Potential food resources available to Malleefowl *Leipoa ocellata* in marginal mallee lands during drought. *Aust. J. Ecol*. **21,** 418-428.

Kentish B. and Westbrooke M. (1993) Crop and gizzard contents of a road-dead Malleefowl. *Emu* **93**: 130-132.

Lewis M.J. (2007) Foraging responses of the endangered Gouldian Finch to temporal differences in seed availability in northern Australian Savanna Grasslands. In 'Temporal explicitness in Landscape Ecology: The Missing Dimension' eds Professor J. Bissonette and Ilse Storch.

Priddel D. and Wheeler R. (1997) Efficacy of fox control in reducing the mortality of released captive-reared Malleefowl, *Leipoa ocellata*. *Wildlife Research* **24**, 469–482.

Priddel D., Wheeler R. and Copely P. (2007) Does the integrity of mallee habitat influence the degree of Fox predation on Malleefowl (*Leipoa ocellata*)? *Emu* **107,** 100-107.

Priddel D. and Wheeler R. (2009) The impact of introduced predators on two threatened prey species: A case study from western New South Wales. *Ecological Management and Restoration* **10,** S117-S123.