Manipulating feral goat access to water in the Rangelands

Russell, B. G.[1], Letnic, M.[2], and Fleming, P. J. S.[3]

[1]Pest Management Unit, Department of Environment, Climate Change and Water, PO Box 1967, Hurstville, New South Wales 2220, Australia

[2]School of Natural Sciences, University of Western Sydney, Hawkesbury Campus, Richmond, New South Wales 2743, Australia

[3]Vertebrate Pest Research Unit, Industry and Investment NSW, Orange Agricultural Institute, Forest Road, Orange, New South Wales 2800, Australia.

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Abstract

Feral goats are a recognised threat to biodiversity and their management in the rangelands is difficult. Using the dependence of feral goats for regular water, we investigated the effectiveness of strategic goat-proof boundary fencing to reduce goat abundance and impact on conservation reserves. Twelve months after completing fence construction, feral goat indices significantly declined and there were significant changes in ground cover. The management implications of our findings are discussed.

Introduction

Feral goats *Capra hircus* are a major threat to biodiversity in New South Wales, impacting 94 entities listed under the Threatened Species Conservation Act 1975 (Coutts-Smith *et al.* 2007). Although widespread across NSW, their distribution and ecology changes from east to west (West and Saunders 2007). In eastern NSW, they live in isolated high density populations with small home ranges and can acquire their water requirements from forage (Fleming 2004; Fleming *et al.* in prep; West and Saunders 2007). In contrast, in the rangelands of western NSW their populations are contiguous (West and Saunders 2007) although lower in density with larger home ranges (Fleming *et al.* in prep) and they must drink regularly to meet their water requirements (Sarawaswat and Sengar 2000). The proliferation of artificial watering points (AWPs), such as tanks and bores for watering stock in western NSW, has allowed feral goats to expand further than would otherwise be the case (Fensham and Fairfax 2008). Focusing control efforts such as trapping, mustering and shooting around AWPs can rapidly remove large numbers of goats (Edwards *et al.* 1997; Fleming *et al.* 2005), however the effectiveness of these programmes tends to be short-term because of rapid reinvasion due to the contiguous nature of the western NSW goat populations (Sharp *et al.* 1999).

Surveys conducted in Nocoleche Nature Reserve and Mutawintji National Park in 2006 indicated goat activity decreased as distance to water increased and was rare more than 4km from water (Letnic unpublished data). In 2008, we received a grant from the National Heritage trust to investigate whether we could alter localized feral goat distribution by manipulating their access to AWPs.

One of the techniques we used involved erecting goat-proof fences in areas where AWPs situated on pastoral land were close to National Park boundaries, such that goats could drink off-park but feed on-park. In this experiment, we used changes in indices, calculated from goat dung, to evaluate the effectiveness of strategic boundary fencing in manipulating feral goat distribution.

Methods

Eight kilometre goat-proof boundary fences were erected at Gundabooka National Park and Paroo-Darling National Park, such that the goats had to travel more than 4km from water to access the park. An additional 15km fence was erected at Gundabooka State Conservation Area, where several AWPs were close together on the neighbouring property, such that each end of the fence was ~4km from the nearest AWP. As goats readily pass through normal stock fencing, the fences were constructed using 8-90-30 hingejoint with a barbed wire strung 20cm above the top of the hingejoint.

The effectiveness of the boundary fences was evaluated through dung and ground cover indices undertaken along 100m transects. Transects were spaced every 500 metres on both sides of the fence (on-park and off-park). The start and end of each transect was marked with an aluminium fence dropper and the location recorded with a GPS. For each survey, a rope was extended along the length of the transect and all fresh black dung within 1m either side of the rope was identified to species and the number of dung groups and the total number of pellets was record. The rope was marked at 5m intervals and the groundcover directly beneath each mark was recorded as either bare ground, grass, forb, litter, log, shrub or tree.

Dung and ground cover surveys were conducted in Spring 2008, before the fences were erected, and again in Spring 2009 after the fences were erected. For comparison, non-treatment transects were also established along equivalent sections of boundary fence with AWPs on the adjacent property where goat-proof fencing was not erected.

The data were analysed using a mixed model ANOVA in SAS Enterprise Guide. There were four fixed factors; distance to water, on or off park, before or after (the fences were built) and treatment or non-treatment.

Results

Goat Indices

The analysis of the data for goat dung groups revealed four significant results; distance to water ($F=9.76$, $P=0.0019$), before/after ($F=6.8$, $P=0.0094$), a before/after by treatment interaction ($F=15.42$, $P<0.0001$), and a before/after by treatment by distance to water interaction ($F=5.55$, $P=0.0188$). The number of goat dung groups per transect significantly decreased at the sites where the fences were built, but did not change at the non-treatment sites (Fig. 1). Overall, there was a negative relationship between goat dung and distance from water, such that the number of dung groups per transect were higher closer to water and lower further from water. However, this relationship broke down at the treatment sites after the fences were built.

Ground Cover

There was more bare ground off-park than on-park ($F=5.72$, $P=0.0171$) both before and after the fences were erected. Apart from this, the results for bare ground mirrored those for goat dung, with distance to water ($F=9.06$, $P=0.0027$), before/after ($F=15.13$, $P=0.0001$) and the before/after by treatment by distance to water interaction being significant ($F=5.52$, P=0.0192). As with goat dung, there was a negative relationship with distance to water, which broke down at the treatment sites after the fences were built.

Although there was a significant positive relationship between the amount of grass and distance to water (F=15.65, P<0.0001), there wasn't a before/after by treatment interaction, i.e. the distribution of grass wasn't affected by the fences within the 12 months of the project. However, for litter there was both a before/after by treatment interaction (F=12.6, P=0.0004) and before/after by treatment by distance to water interaction (F=7.86, P=0.0052). After the fences were built, the amount of litter increased at the treatment sites, but remained the same at the non-treatment sites and the positive relationship between distance to water and the amount of litter broke down at the treatment sites.

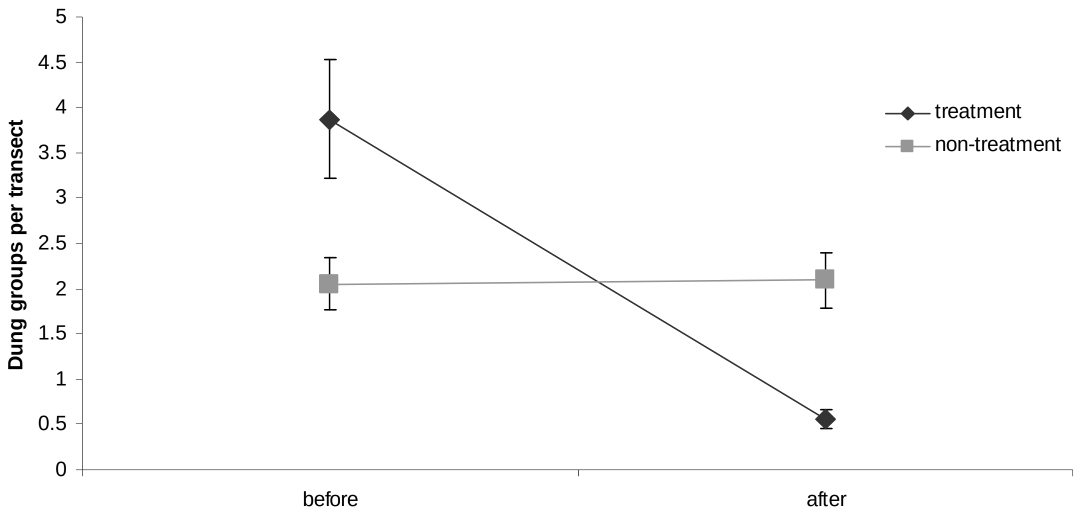

Fig.1. Mean ± SE number of goat dung groups per transect in the treatment and non-treatment sites before (Spring 2008) and after (Spring 2009) the goat-proof fences were erected at the treatment sites.

Discussion

These results clearly show that feral goat dispersion and distribution in the Rangelands are affected by their proximity to water and that feral goat numbers can be significantly reduced at a local scale by manipulating their access to AWPs. Although the fences reduced goat numbers along the boundary, there was not a build up of goat numbers along the goat-proof fence on the side closest to the AWPs. Rather, it would seem that once their regular pattern of feeding on-park but watering off-park is disrupted, they establish a new pattern in a different direction relative to the AWP. The results of the ground cover surveys are quite encouraging, with a response to lower goat numbers apparent after only 12 months. Although there was no response detected for living vegetation, the increase in litter is likely caused by reduced goat feeding on both living browse and litter (Squires 1980). This should provide a better germination matrix than bare ground and improved landscape function in terms of nutrient capture and retention (Facelli and Pickett 1991) leading to increased living vegetation cover in the future.

This non-lethal technique reduces goat impacts on-park without removing the potential for neighbouring landholders to use these goats resident on their property as a resource. However, this technique can also be used strategically to counter the larger problem for goat management in the rangelands of rapid reinvasion following other control programmes (Sharp *et al.* 1999). Immigration into conservation reserves will take place where watering points are close to the boundary. By closing on-park AWPs within 4 km of the boundary and strategically fencing where off-park AWPs are within 4km, these immigration routes can effectively be closed. Subsequent on-park control programmes, be they trapping, mustering or shooting should then achieve longer-term reduction in goat numbers.

Recognition of the importance of proximity to water to goat distribution and the adoption of manipulating their access to water as an important management tool should lead to a substantial improvement to our ability to manage feral goats in the Rangelands.

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