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Virtual fencing aids rest-based grazing and mustering in an extensive cattle grazing system

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Abstract
Virtual fencing (VF) remotely manages livestock grazing using GPS-enabled collars that communicate the location of boundaries to animals. This technology has been demonstrated in cattle, with commercial use occurring in Tasmania and Queensland. VF is of particular interest for livestock management in rangeland environments where property size and topography can reduce the economic viability of installing new fencing infrastructure.

This research aimed to assess VF as a tool to facilitate rest-based grazing and aid mustering in an extensive beef grazing system. A trial involving 100 mixed breed heifers was undertaken at Wintinna Station (via Coober Pedy) in South Australia from April – October 2023. During the trial, the cattle were trained to a commercial VF system. A range of inclusion zones were established in different areas of a 4,500ha paddock with a central dam. Cattle were successfully contained by the VF system and grazed within each new inclusion zone once activated. The VF system was also used to aid in mustering the trial paddock. A virtual laneway 1km in width was activated 24 hours prior to scheduled mustering and all 100 cattle were contained within it. The following day the laneway was deactivated, and the paddock was mustered by two motorbikes in approximately three hours with no requirement for aircraft. The GPS tracking function of the technology enabled all animals to be accounted for.

The results of this trial indicate that VF can facilitate rest-based grazing practices within extensive beef grazing systems. VF's use as a tool to aid in mustering cattle was also demonstrated. With further development and reduced regulatory constraints, VF could have a significant impact on the way that rangelands are managed into the future.

Introduction
The potential for virtual fencing as a management tool in extensive cattle grazing systems has become an area of interest for Australian pastoralists. Rotational grazing is a valuable tool for protecting soil health (Byrnes et al. 2018). and plant biodiversity in grazing enterprises (McDonald et al. 2019). However, implementing rotational grazing using physical fencing presents significant challenges for extensive grazing systems. The large area of these systems makes temporary fencing and the cost of installing permanent fences impractical (Anderson et al. 2014). Consequently, virtual fencing has emerged as a potential solution to enable rotational grazing and improve management in extensive grazing systems.

Virtual fencing is a GPS-enabled technology that delivers cues to livestock via a collar, encouraging containment or exclusion from a prescribed area. An audio cue paired with an electric pulse informs the animals of the GPS boundary, defining their grazing area.

This study investigated the suitability of virtual fencing to facilitate rest-based grazing in the South Australian rangelands. The role of virtual fencing in aiding mustering was also investigated to assess virtual fencing as a holistic tool for improved operations on cattle stations.

Methods

This experiment was undertaken in Dead Finish paddock at Wintinna Station (via Coober Pedy SA), a 45km^2 (4,500ha) area comprising of uplands and open gently sloping plains with shrubby drainage lines. The predominant pasture species in Dead Finish paddock were Mitchell Grass (*Astrebla spp*.), Bladder Saltbush (*Atriplex vesicaria*), and Flinders Grass (*Iseilema spp.*). The water source in Dead Finish was a dam located in the West/Northwest of the paddock.

In April 2024, one-hundred mixed breed *Bos indicus/Bos taurus* heifers (average liveweight 300 ± 50kg) were selected from the herd at Wintinna Station. The heifers were weighed and confirmed not pregnant via rectal palpation prior to allocation to the trial.

The Vence virtual fencing system and CattleRider virtual fencing collars were used in this experiment (Vence, MSD, San Diego, California, USA). CattleRider collars were fitted to each heifer as per Vence protocols (Purcell, pers. comment). Virtual fences were created using the Vence online computer software and communicated to collars via long range wide area network (LoRaWAN) connectivity and global positioning system (GPS). The virtual fencing was implemented via the collars through administration of audio and pulse signals underpinned by associative learning theory (Lee et al. 2009).

The heifers were trained to the virtual fencing system in a 1.5km^2 (150ha) holding paddock. A virtual fence was activated along the physical boundary fence of the holding paddock for three days. The virtual fence was then changed to exclude the cattle from approximately one third of the paddock for a further four days.

On day 0 of the experiment, the heifers were walked approximately 8km from the holding paddock to Dead Finish. A virtual fence was activated in Dead Finish to exclude the heifers from an approximately 11km^2 (1,100ha) strip along the northern boundary of the paddock. On day 28, the virtual fence was changed to create an approximately 16km^2 (1,600ha) rectangular grazing area in the southwest of Dead Finish. On day 92, a capture lane (1km wide, 5km long) was activated to concentrate the cattle prior to mustering. Twenty-four hours later the capture lane was deactivated, and the cattle were mustered on two-wheeled motorbikes and walked approximately 8km to the closest cattle yards.

GPS heat maps were generated using the Vence virtual fencing online computer program and contain information from activation to deactivation of each virtual fencing configuration.

Results

The training period was successful with effective exclusion from one third of the training paddock achieved for four days (Fig. 1). Minor breaches of the virtual fence occurred during this time, indicated by blue shading within the red exclusion zone in Fig. 1.

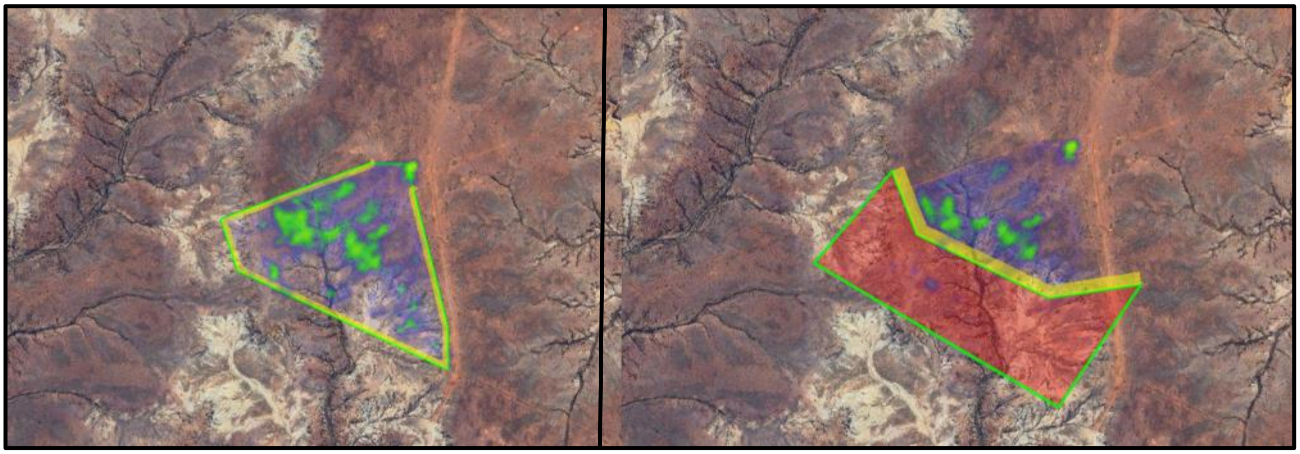

Fig. 1. Virtual fencing configurations and GPS location heat maps in the holding paddock during the training phase

A virtual fence successfully excluded the heifers from the northern boundary of Dead Finish for 27 days. Grazing distribution across the allocated area was relatively uniform with some concentration of grazing around shrubby drainage lines (Fig. 2). There were minor breaches of the virtual fence along a main drainage line through the virtual fence, indicated by blue shading along the prominent creek line in Fig. 2.

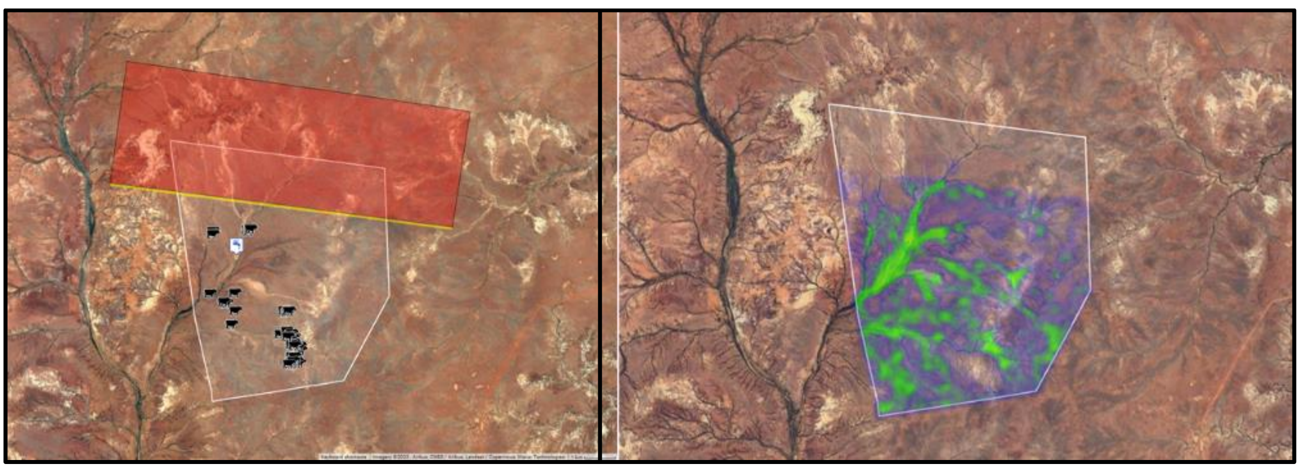

Fig. 2. The virtual fence configuration and GPS location heat map in Dead Finish from day 0 to end of day 27

The heifers were effectively contained within the Southwestern corner of Dead Finish by the virtual fencing system (Fig.3). Grazing locations were uniform across the allocated area. However, locations surrounding shrubby drainage lines were accessed more heavily, indicated by green shading in Fig. 3. There were breaches of the virtual fence along drainage lines to the west, north and east of the allocated area.

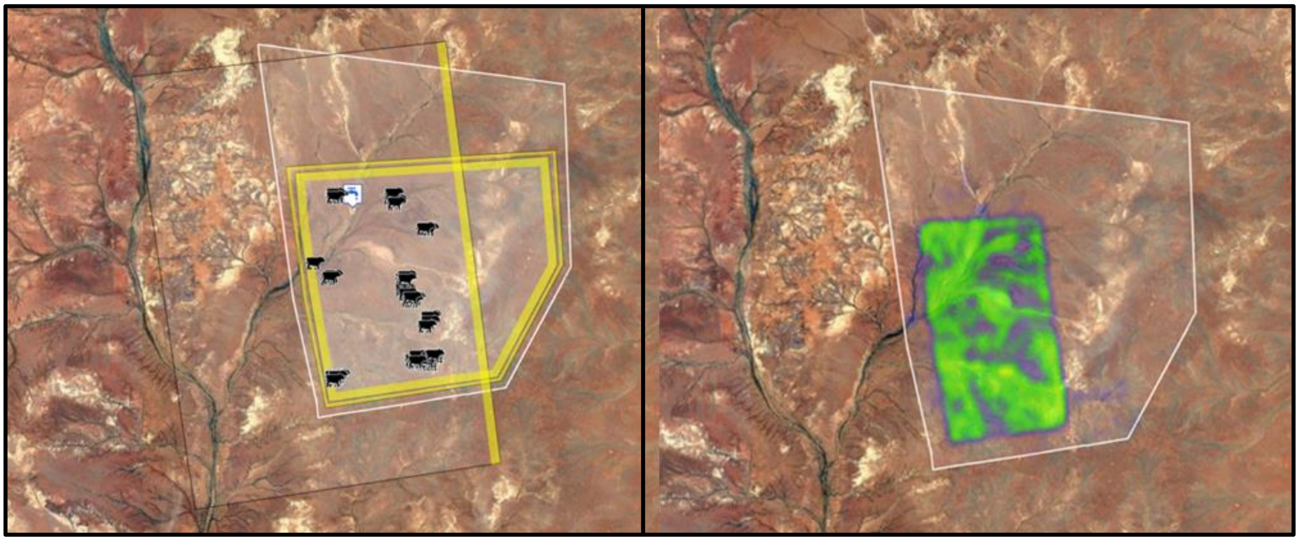

Fig. 3. The virtual fence configuration and GPS location heat map in Dead Finish from day 28 to end of day 91

The capture lane on day 92 effectively contained the heifers during the 24 hours prior to mustering. When the capture lane was deactivated immediately prior to mustering, all collars successfully received the instruction. All 100 heifers were mustered from Dead Finish within three hours by two people on two-wheeled motorbikes.

Discussion

Virtual fencing effectively contained heifers to specified areas within Dead Finish. Minor breaches of the virtual fence occurred throughout the experiment. However, overall containment of the heifers was acceptable. Breaches occurred mostly along drainage lines through the virtual fences. This was most likely due to the presence of moisture and abundant palatable pasture species in these areas. On day 61 of the experiment, a storm occurred at Wintinna Station and 35mm of rainfall was recorded. Twelve heifers breached the virtual fence during this storm, contributing to the GPS location recordings outside of the allocated grazing area. It is common for cattle to travel large distances through physical fences during a storm (Fennell, pers. Comment). The virtual fencing allowed identification of those who had breached the boundary and assurance that they had returned following the storm.

Virtual fencing improved the efficiency of mustering the heifers from Dead Finish. The use of a capture lane to condense the heifers prior to mustering saved the labour of two people for two hours each and the cost of an aircraft. Utilising virtual fencing enabled mustering of 100% of the heifers in Dead Finish, a very rare occurrence on cattle stations of this size.

Virtual fencing shows promise as a tool for improved grazing management and mustering efficacy in extensive cattle grazing systems. The use of virtual fencing at Wintinna Station increased monitoring of animals, reduced labour inputs, improved pasture management through rotational grazing and improved farm safety through reduced requirement for large musters and aircraft. The availability of virtual fencing to Australian pastoralists has the potential to contribute to sustainable rangeland management into the future.

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