Dairy Australia

Australian Government
Department of Agriculture

VIRTUAL HERDING RESEARCH UPDATE

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'Enhancing the profitability and productivity of livestock farming through virtual herding technology' is a four-year project that began in July, 2016 to evaluate the application of virtual herding (VH) technology across different production systems and examine the responses of different livestock (dairy cattle, beef cattle, sheep) to various cues and stimuli to improve productivity and profitability in the livestock industries.

The project received $2.6 million from the Australian Government through its Rural R&D for Profit program. A further $1.365 million has been provided by a number of Rural Research and Development Corporations and R&D providers. The R&D providers include, CSIRO, the University of Sydney, University of New England, the Tasmanian Institute of Agriculture, University of Melbourne and Agersens Pty Ltd, with additional contributions from Dairy Australia, Meat and Livestock Australia, Australian Wool Innovation and Australian Pork Limited.

Using VH, the research team will investigate the potential to constrain animals to certain areas (better grazing management and environmental outcomes), autonomously herd animals, or move individual or groups of animals in a herd differently to the rest of that herd. Fundamental research involving behavioural observations and physiological measurements will be critical to ensure that the technology does not compromise animal welfare.

Update on Sub-program Activities

Sub-program 1: Optimising the animal responses to virtual herding technology.

Virtual fencing versus electric tape fencing

Earlier in 2019 (January to March) Dr Dana Campbell and Dr Caroline Lee, together with CSIRO technicians Jim Lea and Troy Kalinowski, conducted a trial to compare the effectiveness of virtual fencing (established with the pre-commercial prototype of the eShepherd™ system) versus electric tape fencing. Eight paddocks were established on site at CSIRO in Armidale to contain eight Angus steers each. The eight paddocks had either a single virtual fence line or a single electric tape line placed to exclude the cattle from one section of the paddock for a period of four weeks.

The results showed that:

- Some steers did break through the virtual fence line within the first few days while they were learning the association between the audio and electrical cues. However after this initial period, GPS location data showed that both types of fences contained the animals.
- Measurements of standing and lying behavioural patterns via automated devices attached to each steer's leg showed minimal differences between animals exposed to the two types of fences.
- Analyses of faecal samples for stress hormones showed no differences in stress responses towards the different fence types.

- All animals were able to learn to respond to the audio cue alone with more audio cues received than electrical pulses (Figure 1), although there was individual variation in their learning.

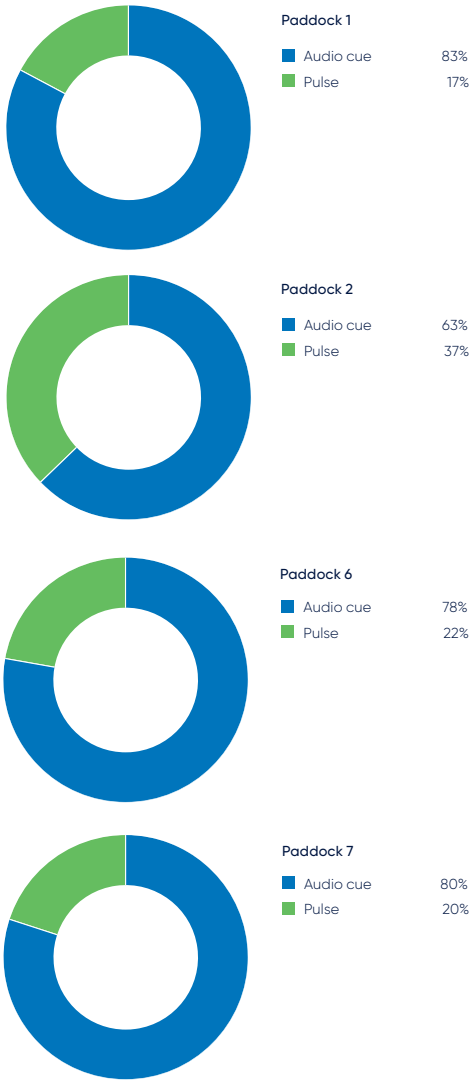

Figure 1 The relative percentages of audio cues and electrical pulses for the four weeks in each of the four paddocks that had a virtual fence.

These results indicate that virtual fencing technology can effectively contain animals in a prescribed area with no significant behavioural and welfare impacts detected in this study.

Trial at Eden Valley to assess environmental outcomes

CSIRO Research Scientists, Dr's Dana Campbell, Caroline Lee, Rick Llewellyn along with CSIRO technicians Jim Lea, Damian Mowat, and Jackie Ouzman conducted a trial mid-2019. They used pre-commercial prototypes of the eShepherd™ virtual fencing system to assess the application of the technology to exclude cattle from an environmentally-sensitive area.

The trial was conducted on a commercial property in Eden Valley, SA, using 20 Santa Gertrudis heifers. The animals were fitted with the eShepherd™ neckbands and given a couple of days to get used to the neckbands before placing the cattle into a 14 hectare paddock containing a regenerative planting of native saplings. The cattle were initially trained to a straight fence line placed in front of the trees but over the first two weeks this was modified to an angled fence fitted around the sapling plantation (Figure 2).

GPS movement patterns showed that the virtual fence successfully prevented animals from accessing the saplings for five weeks. Analyses of the signals delivered to the animals confirmed previous findings in that all animals were able to learn that the audio tone predicted the subsequent electrical pulse, but at varying rates amongst individual animals. Similarly, animals continued to interact with the virtual fence line over the duration of the study.

The data from this study are still being collated to provide precise patterns of behaviour for each animal over the trial duration and to show the impact of grazing exclusion on pasture biomass.

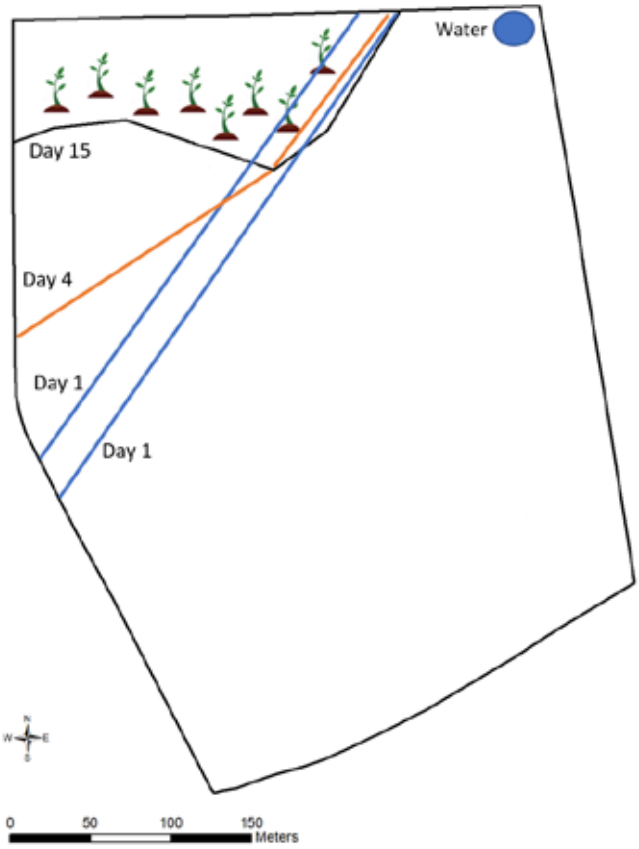

Figure 2 Map of the paddock at Eden Valley showing the succession of fence lines protecting regenerative saplings that were presented to the animals across the days of the trial.

Sub-program 2: Determine the best livestock and pasture management for intensive dairy and beef through more controlled pasture allocation.

Research funded through the Commonwealth Department of Agriculture Rural R&D for Profit Program has revealed variation between individual cattle in learning the association between audio and electrical stimuli which is essential to successful virtual fencing. A better understanding of factors that can influence this associative learning may ensure all animals adapt in systems that utilise virtual fencing technology.

Using manually operated collars, Dr. Megan Verdon from the Tasmanian Institute of Agriculture investigated the effects of prior experiences and of temperament on associative learning of the different cues in dairy heifers. Thirty heifers were reared to six months of age (Figure 3) with or without exposure to electric fencing. The pairing of audio and electrical stimuli was then assessed in a feed attractant trial using manual training collars. The response of heifers to the sudden and unpredictable presentation of an unfamiliar object (a brightly coloured umbrella) was also used to measure underlying fearfulness of heifers.

Figure 3 Replacement dairy heifers that were used in the study to determine the effects of experience with electric fencing on subsequent response to virtual herding technology

Heifers with experience of electric fencing showed more rapid learning of the association between audio and electrical stimuli than those heifers that had no exposure to electric fencing during rearing The more interactions a heifer had with the electric fence during the treatment period, the lower the proportion of electrical stimuli she received during training. Bold heifers (indicated by a short latency to interact with the umbrella) were more likely to ignore all stimuli to reach the feed attractant during training.

Experience and interactions with electric fencing are associated with the day-to-day management of cattle in intensive pastoral systems. This may prime dairy cattle to more rapidly accept virtual fencing technology. Furthermore, there are differences between heifers in the speed of associative learning that may be due to variation in how the animal perceives the audio cue and the electrical stimulus.

Latest News:

- Dr Dana Campbell attended the International Society of Applied Ethology Regional Conference in New Zealand on 21/22 November and presented a paper on the behavioural and welfare comparison of electric tape and virtual fencing in cattle. At the same ISAE Regional Conference, Dr Danila Marini presented a paper the effects of the social influence on the effectiveness of virtual fencing in sheep.
- Patricia Colusso presented a paper on her PhD work at the Dairy Research Foundation Symposium in Bega NSW in July. The presentation described the response of dairy cattle to the learning protocols of a virtual fence.
- The eighth Milestone Report for the project is being prepared and will be submitted to the Department of Agriculture in December, 2019.
- The 6-minute video describing virtual herding and demonstrating how animals respond to it has been viewed over 300 times. If you haven't seen it, you can access the video at **dairyaustralia.com.au/farm/animal-management/technologies/virtual-herding-program**.
- Leandro Posteraro has recently joined Agersens as the eShepherd™ Product Owner and will take the lead in marketing the eShepherd™ system.
- Sally Haynes has worked for Agersens almost since the company began. Sally's role has expanded to include the management of Animal Applications Development where she is responsible for the R&D trials conducted by Agersens as well as providing liaison between Agersens and the Project Team.
- Dr Caroline Lee presented a paper, "Virtual herding for cattle and sheep" at the 9th National Animal Welfare RD&E Forum held at The University of Melbourne on 6 November.
- Congratulations are in order for the CSIRO and Agersens Teams on receiving the prestigious CSIRO Entrepreneurship Award for 2019. The award recognises the application of an entrepreneurial approach between a team and a customer under conditions of ambiguity and uncertainty. It is designed to celebrate those who use passion, persistence and resourcefulness to turn an opportunity into reality. The Award was presented to the teams at a ceremony at Parliament House, Canberra on 28 November. Team members from CSIRO were Dave Henry, Caroline Lee, Brian Thomas, Dana Campbell, Jim Lea, Sue Belson, Greg Bishop-Hurley, Phil Valencia and Rick Llewellyn, and from Agersens were Ian Reilly, Jason Chaffey, Chris Leigh-Lancaster, Sally Haynes and William Farrer.

FOR FURTHER INFORMATION

The website for this project has been established on the Dairy Australia website **dairyaustralia.com.au/farm/animal-management/technologies/virtual-herding-program**. The site contains information about project activities and recent news about the Project, including copies of a number of presentations that members of the Project Team have made to industry over the past few months.

Agersens also have a website at **agersens.com/** where you can keep up to date with the progress of commercialisation of this exciting technology.

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