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Using VF technology to better manage sheep.

Dr Danila Marini
Angaston Ag day – 23rd of March

Dairy Australia
mla MEAT & LIVESTOCK AUSTRALIA
awi Australian Wool Innovation Limited
AUSTRALIAN Pork
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THE UNIVERSITY OF MELBOURNE
THE UNIVERSITY OF SYDNEY
tia TASMANIAN INSTITUTE OF AGRICULTURE
une University of New England
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To contain livestock without the use of a fixed fence, using signals to the animals.

Background

- Each animal wears a GPS enabled collar containing patented training software that trains the animal to move or stay with a boundary set up by the farmer.
- Ethical
  - Can cattle and sheep quickly learn to avoid an electric stimulus by responding to an audio cue alone
  - Welfare assurance
- Effective

  Contains animals within the fence boundary

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Potential for spatial grazing on mixed farms

Applications

- Greater control of grazing and optimisation of pasture use
- Improving feed utilization (eg strip grazing)
- Weed management
- Protect environmentally sensitive areas
- Reduce labour costs

Principles of a conventional electric fence

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Conditioned stimulus

(visual)

Associative learning

Contact fence

Unconditioned stimulus

(electrical)

Response

(avoidance)

Principles of a virtual fence

Approaches boundary

Conditioned stimulus

(audio)

No response → Unconditioned stimulus

(electrical)

→ Response

(avoidance)

Associative learning

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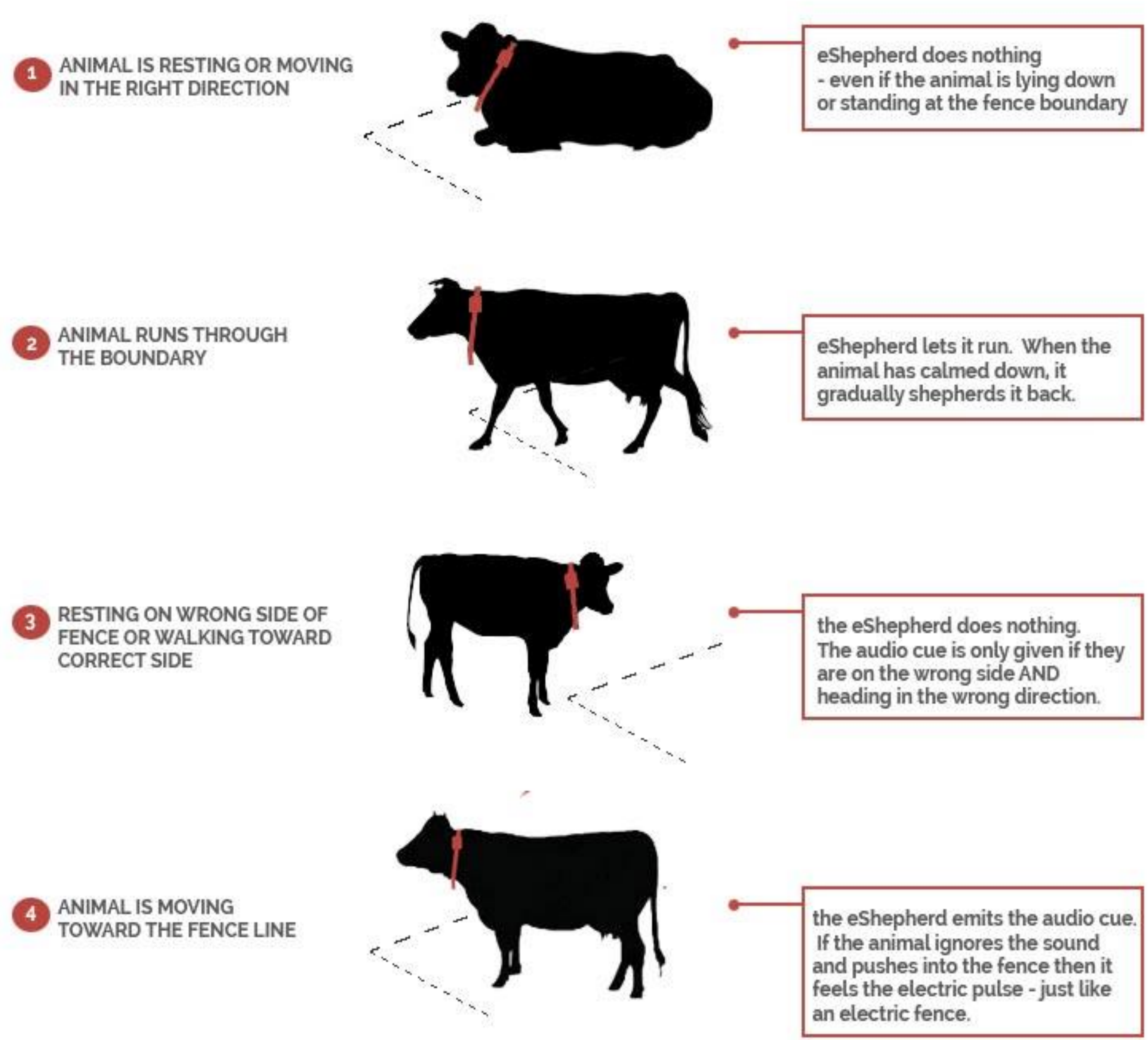

① ANIMAL IS RESTING OR MOVING IN THE RIGHT DIRECTION

eShepherd does nothing
- even if the animal is lying down or standing at the fence boundary

② ANIMAL RUNS THROUGH THE BOUNDARY

eShepherd lets it run. When the animal has calmed down, it gradually shepherds it back.

③ RESTING ON WRONG SIDE OF FENCE OR WALKING TOWARD CORRECT SIDE

the eShepherd does nothing.
The audio cue is only given if they are on the wrong side AND heading in the wrong direction.

④ ANIMAL IS MOVING TOWARD THE FENCE LINE

the eShepherd emits the audio cue.
If the animal ignores the sound and pushes into the fence then it feels the electric pulse - just like an electric fence.

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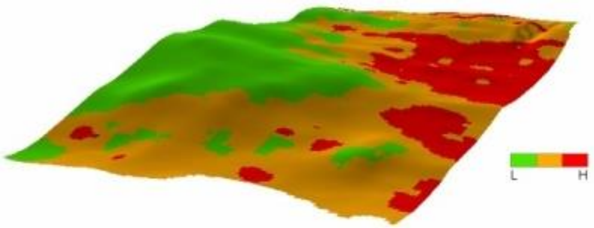
Aims

- To test virtual fencing efficacy with sheep

- Test the effect on welfare

- To make the case for development for sheep



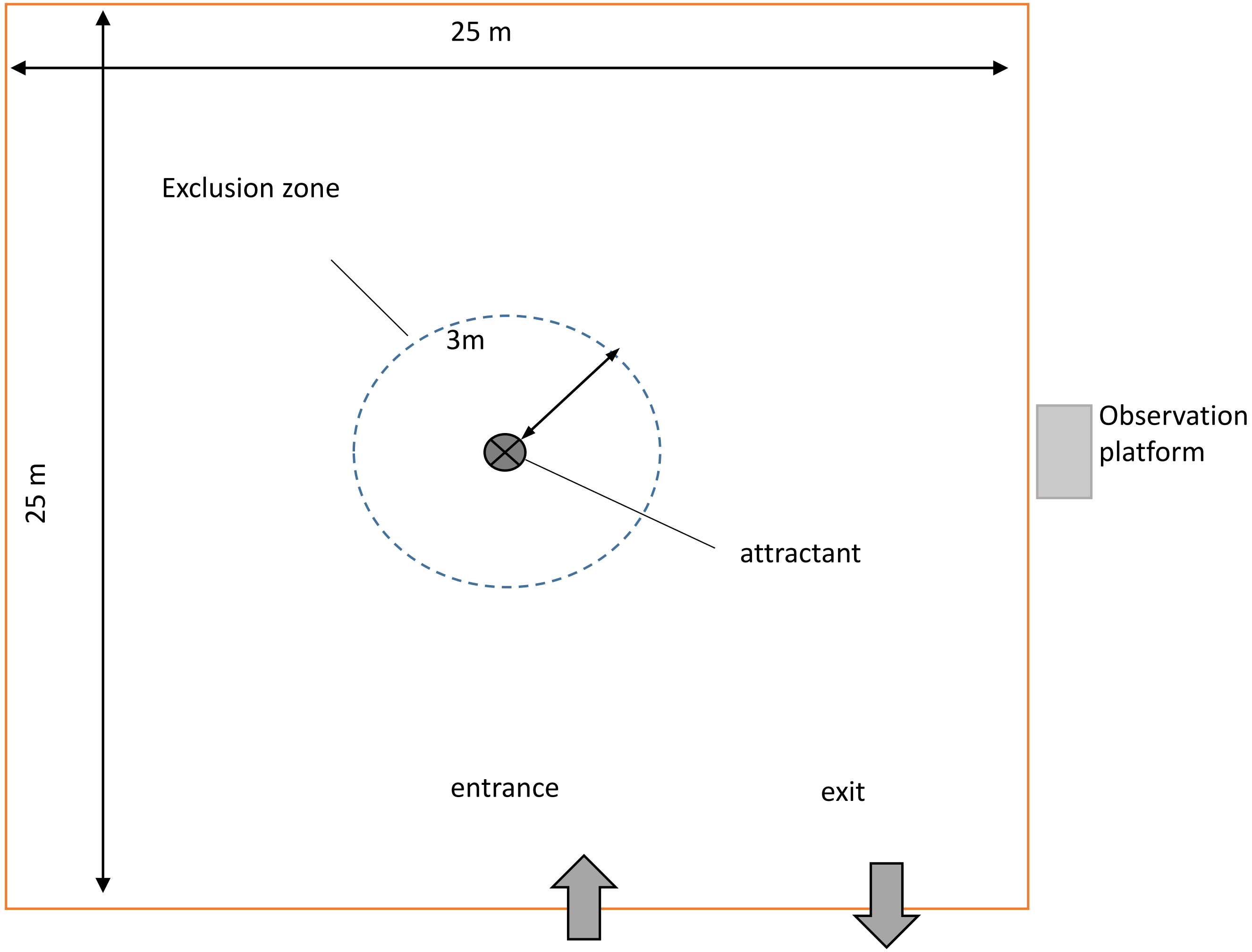
How do we implement the fence?

Most of the virtual fencing work has been done on cattle.

For sheep we still have to answer a lot of questions, device, contact, responses to stimuli, flocking response.

To do this we use Garmin dog training collars that allow us to manually implement an audio cue and electrical stimulus

Experiment 1 and 2: appropriate electric stimulus



25 m

25 m

Exclusion zone

3m

attractant

Observation platform

entrance

exit

Associative learning test

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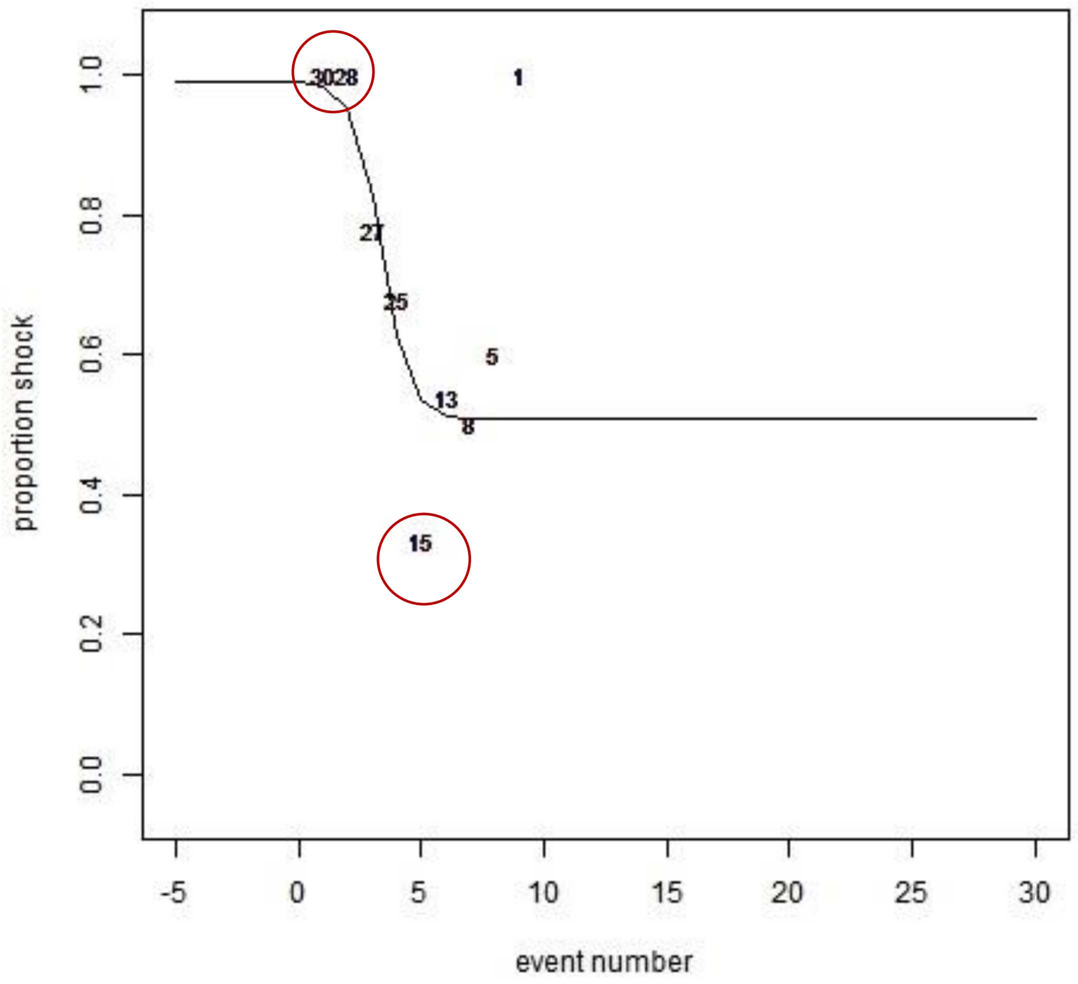
Upper asymptote	Lower asymptote	Sig diff	Point of inflection	Slope
0.99	**0.48**	**< 0.05**	**3.36**	**-1.75**



- A majority of approaches occurred on day 1, when all 30 sheep approached and received an audio cue
- On average it took 3 interactions with the fence for sheep to learn the audio
- The proportion of sheep to receive a stimulus following audio on the fist few interactions is 48%
- Some sheep are sensitive to the audio and will respond without interaction

Training sheep to respond to an audio cue

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Individual animal results

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Brand	Total cue	Total stimulus	Stimulus percentage
10	7	1	**14**
14	9	2	**22**
27	11	3	**27**
24	7	2	**29**
13	8	3	**38**
26	8	3	**38**
44	13	5	**38**
12	10	5	**50**
6	11	6	**55**
34	9	5	**56**
33	6	4	**67**
35	9	6	**67**
36	7	5	**71**
39	11	8	**73**
7	8	6	**75**
18	9	7	**78**
38	7	6	**86**
15	8	7	**88**
5	2	2	**100**
19	4	4	**100**

- High individual variation
- The sheep that didn't appear to learn have very few Interactions
- We picked the top 6 and bottom 6 sheep to use in group test in a paddock

Individual animal results - effect of temperament on learning

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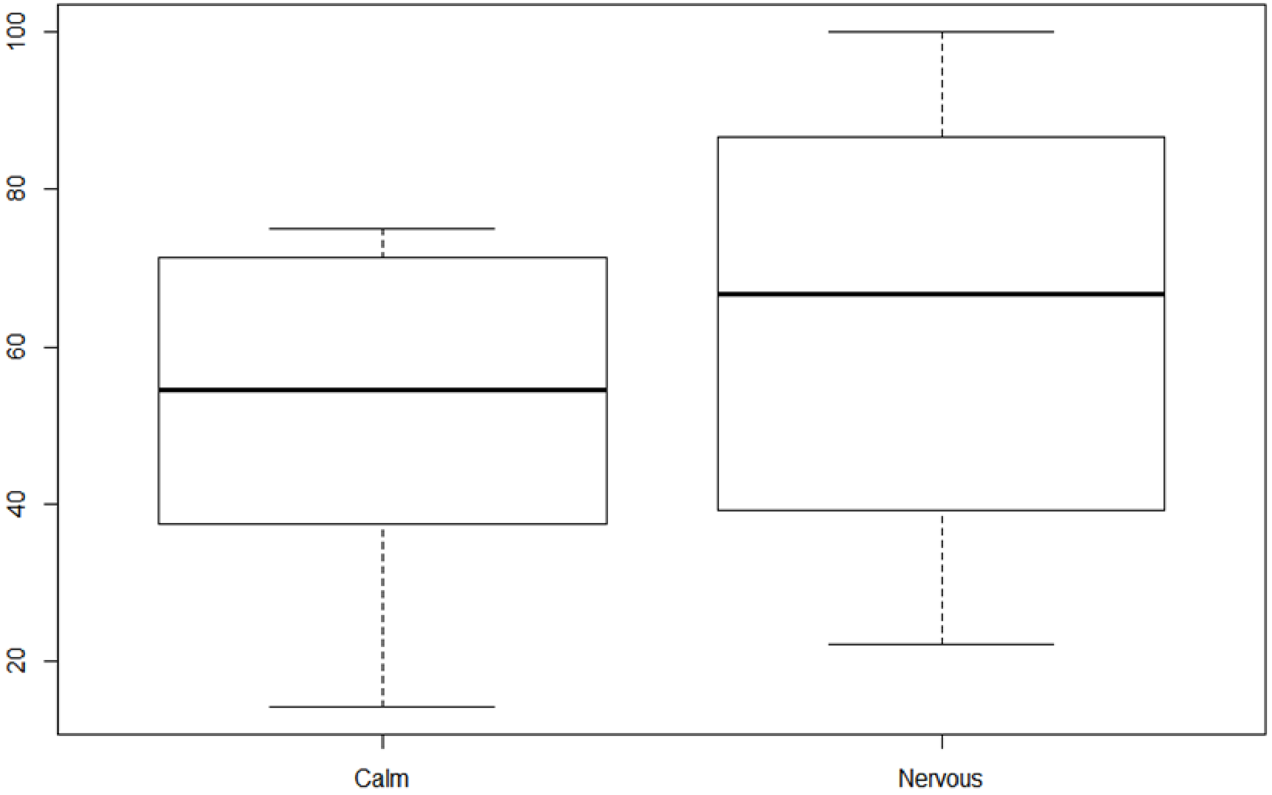

Comparison of the temperament of sheep

Calm (n = 9) and nervous (n = 11) on the proportion of electrical stimuli received after receiving and failing to respond to an audio cue

Group test

Hypothesis: Sheep that demonstrated associative learning were able to respond to the audio cue in a different situation

Group	Audio	Stimulus	Animals reacting to audio
Slow learners	58	8	2
Naïve	45	6	4
Fast learners	28	2	8

Results

- The top 6 of the trained sheep were able to respond to the audio in a new setting

- Naïve sheep were able to learn to respond to the audio without individual training

- Individual approach and interactions with the fence was affected by flock mates

Conclusions

- This study determined a minimal effective level (36 mA, 20 us with 16 pulses delivered per s)

- Further research is required to determine the impact that an electrical stimulus has on sheep welfare

- Can sheep be trained across a diversity of environmental contexts.

Other work

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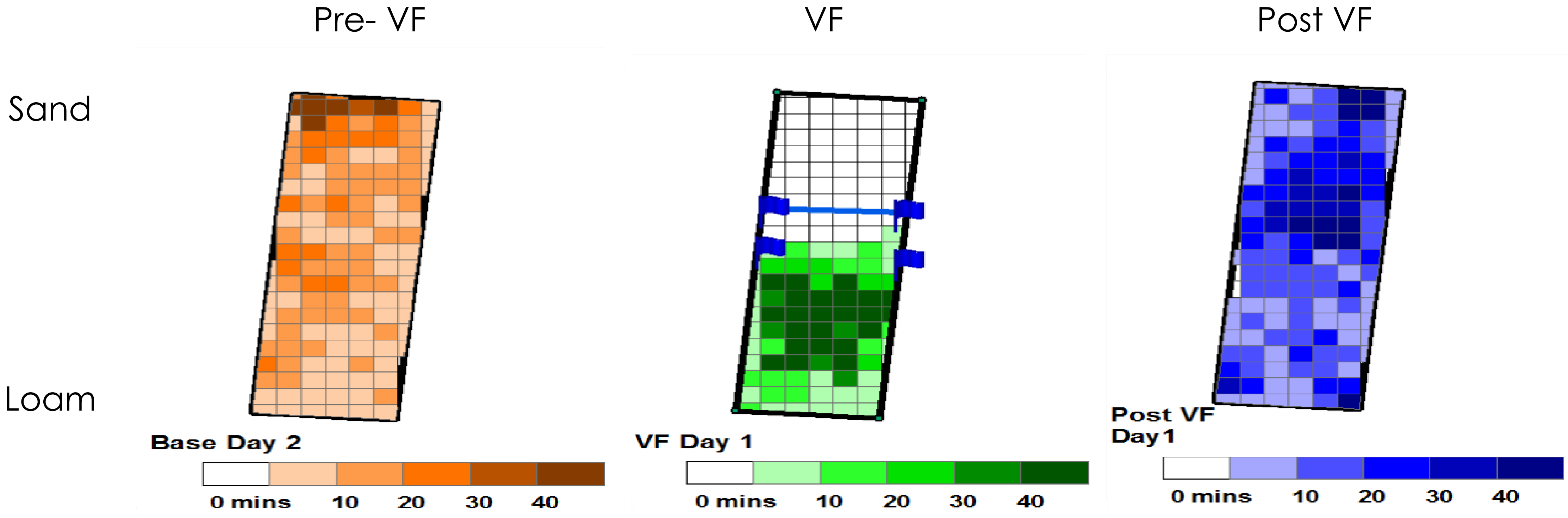
The effect of virtual fencing on paddock utilisation



Day 1 of VF: 52 audio/14 stimulus
Day 3 of VF: 31 audio/4 stimulus

Marini et al 2018

Mallee Sustainable Farming

Virtual fencing impact

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- Virtual fencings adoption and use for weed control using sheep
- Beneficial to Australian farmers facing increasing farm scale, reduced labour
- Potential to greatly improve the effectiveness and scope of application of targeted grazing management.

Virtual fencing impact

Short term impact:

- Further development of VF technology for sheep

Long term impact:

- Reduction in labour costs associated with manual management of sheep grazing
- Decreased fencing infrastructure cost
- Decreased use of herbicides to control weeds

Future work

- Determine the individual variation and group dynamics
- Detailed welfare measurement
- Pasture utilisation
- Legislative change needed in several states
- Investment in development of a feasible technology platform for sheep now needed

Weed management using virtual fencing

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Dr. Rick Llewellyn

Group Leader,
Integrated Agricultural Systems

Dr. Dave Henry

Research Leader,
Digital Agriculture

Dr. Caroline Lee

Principal Research Scientist

Sue Belson, Jim Lea, Troy Kalinowski, Michael Moodie, Jackie Ouzman, Damian Mowat, Matthew Williams, Allen Buckley

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Application of VF in sheep wool and meat enterprises.

Dr. Danila Marini

UNE
Postdoctoral fellow

Dr. Fran Cowley

UNE
Lecturer, Livestock
Production

Professor David Lamb

UNE
McClymont
Distinguished Professor
(Research)

Dr. Mitchell Welch

UNE
Lecturer in Computer
Science

Dr. Caroline Lee

CSIRO
Principal Research
Scientist

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Thank you

More information:

- http://www.dairyaustralia.com.au/Animal-management/Technologies/Virtual-Herding-Project.aspx
- http://agersens.com/