



Northern Beef Research Update Conference

Bush to bright lights

19–22 August 2019



Conference program



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Welcome

Dear colleagues

On behalf of the Organising Committee I am excited to welcome you to the Northern Beef Research Update Conference (NBRUC), at the Brisbane Convention & Exhibition Centre (BCEC) from 19 to 22 August, 2019. Hosted by the North Australia Beef Research Council (NABRC), the 2019 NBRUC Conference is a fresh opportunity for people working or interested in the Australian beef industry to gather, network, learn and share technical information about important areas of beef cattle research and management.

The Organising Committee is this year proud to host the Conference in Brisbane, a bright and tenacious city that balances its growing entertainment district with a relaxed, welcoming atmosphere. I encourage you to join us at a conference that has a community feel, to witness presentations from international keynote speakers and leading industry experts on topics ranging from genetics, nutrition and farming systems, to animal welfare and health, agri-tech, smart farming and building human capacity for a sustainable industry.

In addition to a top quality program, NBRUC 2019 will also feature social opportunities that aim to inspire long-lasting connections between both participants and sponsors.

I encourage you to use the next two days to network, debate and share your expertise and experiences with other delegates who have travelled from across our vast country, and indeed around the planet, to attend NBRUC 2019. It is inspiring to see so much enthusiasm and passion for our industry gather in the one location and I would like to thank you all for being a part of it.



Andrew Gray
NBRUC 2019 Chair

Organising committee



Andrew Gray



Bob Karfs



Kieran McCosker



Luis Prada e silva



Nigel Tomkins



Bronwyn Venus

NBRUC 2019 Conference app

Don't miss any highlights, use the app to easily build your own personal agenda of the sessions you wish to attend! Gain access to the program, invited speaker information, oral and poster abstracts, sponsor information, and message other delegates who have downloaded the app.

Use the QR code to download the app on your smartphone, it's simple!

Apple



Android





We encourage you to opt in when you download the app to ensure you are able to use all of the interactive features.

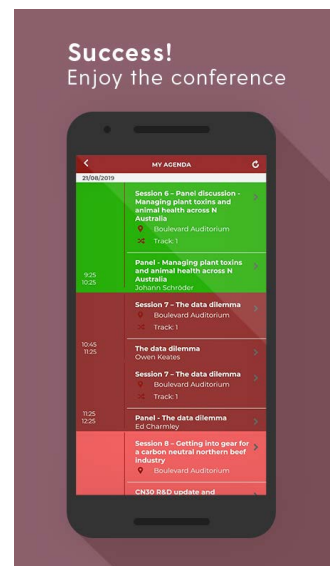
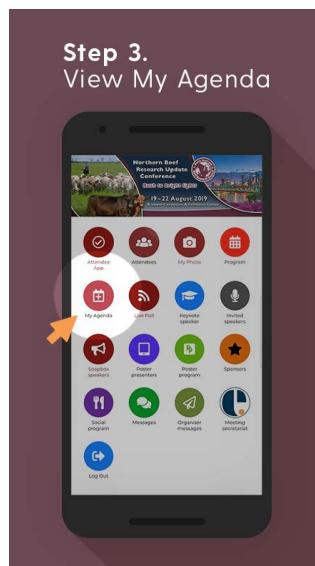
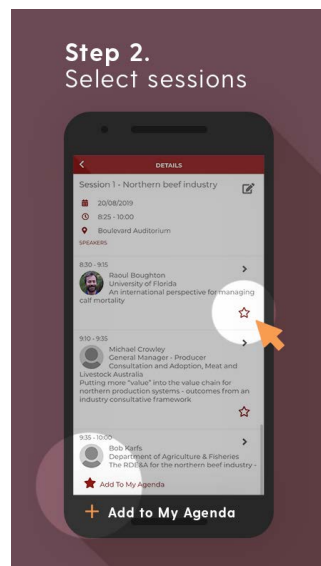
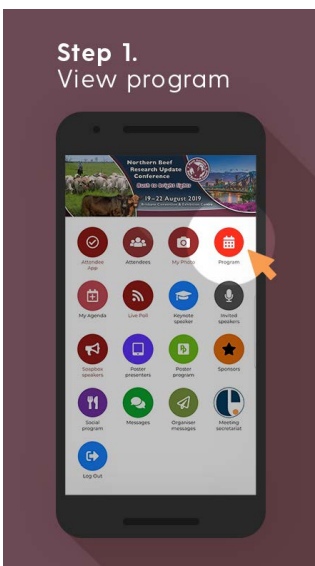
The first time you open the app, you will need to enter this code: **nbruc-app**

Log in using the account email address and password you created when you registered, or the four digit pin that was emailed directly to you. If you can't recall your password, you can submit a reset password request which will be emailed to you.

My Agenda

Build your personal agenda by browsing the program and selecting the  for the sessions you wish to attend. Then simply use the  Add To My Agenda section on the app to easily navigate sessions throughout the conference, without having to scroll through the whole program.

If you have any issues with the app please see the Expert Events team at the registration desk.



Social events

Welcome reception

Join your fellow delegates, sponsors and exhibitors and kick-off your 2019 NBRUC experience with drinks and light canapes at the welcome reception.

Date: Monday 19 August

Time: 6.30pm – 8.00pm

Venue: Boulevard Auditorium Foyer, BCEC

Cost: Tickets are inclusive for delegates attending the full conference. Day only delegates and guests may purchase tickets at an additional cost of \$65 per ticket

Dress code: Smart casual



Conference dinner

Your favourite MC, Jean Kittson is back to host this year's conference dinner with her witty banter and humorous delivery. Join us at the greatly anticipated conference dinner for a gourmet three-course meal and drinks package and cheer on your colleagues during the presentation of the 2019 NABRC Medals.

Date: Tuesday 20 August

Time: 6.30pm – 10.30pm

Venue: The Grand Ballroom and Grand Balcony
The Greek Club, 29 Edmonstone Street
South Brisbane Q 4101

Directions:

The Greek Club is an 8-10 minute walk from Rydges South Bank. Please click here to view a map.

<https://goo.gl/maps/EsD5QvdpoGsieNo79>

Cost:

Tickets are inclusive for delegates attending the full conference. Day only delegates and guests may purchase tickets at an additional cost of \$135 per ticket.

Dress code: Cocktail

After party

Celebrate the success of the conference with colleagues whilst enjoying the bright lights of Brisbane's CBD from the South Bank beer garden.

Date: Wednesday 21 August

Time: 6.30pm onwards

Venue: Southbank Beer Garden
30ba Stanley Street Plaza
South Bank Q 4101

Directions:

Southbank Beer Garden is a 5 minute walk from Rydges South Bank. Please click here to view a map.

<https://goo.gl/maps/KsixNkSv6Z35Vg71A>

Cost:

Tickets are inclusive for delegates attending the full conference. Day only delegates and guests may purchase tickets at an additional cost of \$100 per ticket.



Dress code: Smart casual or

Theme: Viva BrisVegas!

Keynote speakers



Raoul Boughton

Tuesday 20 August, session 1, 8:25am, Boulevard Auditorium

An Australian national now living in the United State of America, Raoul has a B. App. Sc. in Environmental Resource Management from the University of New England, a PhD in biology from the University of Memphis, and two post-doctoral fellowships on avian disease ecology and population viability. Over the last decade, his expertise on wildlife eco-physiology has transitioned to include the interaction of wildlife populations with livestock production. Since 2014, he has been at the University of Florida Range Cattle Research and Education Center. Current research includes understanding causes of calf loss, the wildlife-livestock-environmental interface, and impacts of invasive vertebrate species on the environment and livestock production.

www.rangelandwildlife.com



Robert Faff

Tuesday 20 August, session 3, 1:00pm, Boulevard Auditorium

Robert Faff is Professor of Finance and formerly Director of Research at the UQ Business School. He has an international reputation in empirical finance research: securing **14 Australian Research Council grants** (funding exceeding **\$4 million**); **>310** refereed journal publications; career **citations >12,600** (Google Scholar); and a **h-index of 57** (Google Scholar). His particular passion is nurturing and developing the career trajectories of early career researchers. Robert has supervised approximately **40** PhD students to successful completion and examined **50** PhD dissertations. Building on a 35-year academic career, his latest focus is “Pitching Research” [<https://ssrn.com/abstract=2462059>], now gaining great traction domestically and worldwide as exemplified by: (a) **>13,300** SSRN downloads; (b) **>290** pitching talks/events; (c) at **37** Australian universities; and (d) spanning **52** different countries. In addition, Robert is Editor-in-Chief of Pacific-Basin Finance Journal; formerly: Editor of *Accounting and Finance* (2002-2011) and Associate Editor of several journals including *Abacus* and *Australian Journal of Management*.

Together we're building a prosperous and resilient beef cattle industry.

We're supporting the Queensland beef industry with long-term investment in world class research, development and extension programs.

With state-of-the-art beef research facilities and staff with a wide breadth of skills, we conduct and extend science that has real on-ground impact.

We work collaboratively with leading Australian and international research organisations to deliver timely and practical industry solutions.

The Queensland Government's Department of Agriculture and Fisheries is a proud sponsor of the 2019 Northern Beef Research Update Conference.



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Queensland
Government



Scientific program

MONDAY, 19 August 2019

4.30pm – 8.00pm

Conference Registration

Boulevard Auditorium Foyer, Boulevard Level, Brisbane Convention and Exhibition Centre (BCEC), South Brisbane

6.30pm – 8.00pm

Welcome Reception

Official welcome from Jason Strong, Managing Director, Meat & Livestock Australia
Boulevard Auditorium Foyer, BCEC

TUESDAY, 20 August 2019

7.00am

Conference Registration

Boulevard Auditorium Foyer, Boulevard Level, BCEC

8.00am

Boulevard Auditorium

Welcome

Andrew Gray, Chair NBRUC Organising Committee

Conference Opening

Hon. Mark Furner MP Minister for Agricultural Industry Development and Fisheries

Session 1 – Northern Beef Industry

Chair – Ed Charmley

8.25am

Keynote

An international perspective for managing calf mortality - Using technology to help quantify calf loss
Dr Raoul Boughton, Institute of Food and Agricultural Services, University of Florida

9.10am

Putting more “value” into the value chain for northern production systems

Mick Crowley, Meat & Livestock Australia

9.35am

The RDE&A for the northern beef industry – feast or famine

Bob Karfs, DAF

10.00am

Morning tea – Boulevard Auditorium Foyer

Session 2 – Our northern production systems

Chair – Andrew Ash

10:30am

What can we learn from producer experiences?

1. Michael Lyons (Wambiana Station Qld)

2. Jay Mohr-Bell

3. Kevin Bell (Pardoo Station WA) - Grazed irrigated tropical pastures as a beef production system in the Pilbara

11:00am**Panel discussion**

*Ben Barrett, ANZ
Ian McLean, Bush AgriBusiness
Jay Mohr-Bell
Kevin Bell, Pardoo Station WA
Michael Lyons, Wambiana Station*

11:45am

The impact of drought and growing resilience for beef producers
David Phelps, DAF

12:15pm

Lunch – Boulevard Auditorium Foyer

Session 3 – Boulevard Auditorium – Adoption and extension**Chair – Brigid Nelson****1:00pm****Keynote**

Pitching beef research
Robert Faff, The University of Queensland
Top tips for students, post-graduates and career researchers to get their message across the public, peers and funding agencies with impact. Robert will give a "taster" of a hypothetical Shark Tank experience and share some pointers on how the "pitch" can be used towards achieving meaningful engagement and a lasting impression for RDE&A.

2:00pm – 3:00pm**Concurrent session – Soapbox presentations****Boulevard Auditorium – Chair Tim Mahony****Animal welfare**

- **200** The effect of insecticidal fly tags on cattle liveweight gain in the Douglas Daly region, NT, **Tim Schatz**, NTDPIR
- **201** Do insecticidal fly tags protect against three day sickness? **Tim Schatz**, NTDPIR
- **202** A single-shot 5-in-1 vaccination at the time of dehorning/castration and prevalence of 'missing' animals at future mustering events, **Kieren McCosker**, NTDPIR
- **203** Paraboss for cattle; a new web resource to assist with the control of ticks, flies, lice and worms of cattle, **Jess Morgan**, DAF
- **204** Impact of dehorning and wound infection on live weight gain of beef calves, Melissa Wooderson, NTDPIR
- **205** Cattle tick research – realisTICK progress, **Alicja Tabor**, The University of Queensland

Room B1 – Chair Dionne Walsh**Building human capability for a sustainable industry**

- **217** The FORAGE "Pasture Growth Alert" report: assessing risks to pasture growth and pasture resilience, **Grant Stone**, Queensland Department of Environment and Science.
- **218** The role of FutureBeef in marketing and extension, **Jodie Ward**, DAF
- **219** Proposal for consideration: Increasing adoption through campdrafting, **Jane Douglas**, NTDPIR

Room B3 – Chair Maree Bowen**Presentation from Rob Dixon****All things "p"**

- **233** Effective phosphorus supplementation improves profitability, **Maree Bowen**, DAF
- **234** Risk factors of cows associated with plasma inorganic P concentration of calves at weaning, **Kieren McCosker**, NTDPIR
- **235** The post-weaning performance of calves from cows with and without access to P during pregnancy and lactation, **Kieren McCosker**, NTDPIR
- **236** Effect of Phosphorus supplementation on female reproductive performance in phosphorous deficient country in the NT, **Tim Schatz**, NTDPIR
- **237** Phosphorus supplementation and female PIP levels in the VRD, NT, **Tim Schatz**, NTDPIR

Nutrition

- **206** Grazing weaners on oats: the effect of compensatory gain on productivity and profitability, **Kylie Hopkins**, DAF
- **207** Measurements of feed efficiency in protein-deficient diets, **Peter Carmona**, The University of Queensland
- **208** Estimating diet nitrogen use efficiency from isotopes of tail hair in cattle, **Diogo Costa**, The University of Queensland
- **209** Supplementation effects on growth and fertility in lactating Bos indicus cows in the Katherine region, **Kieren McCosker**, NTDPIR
- **210** Desmanthus: A tropical legume for reducing methane emissions in Northern Australian beef cattle, **Bénédicte Suybeng**, James Cook University
- **211** Progrades Desmanthus - an update, **Chris Gardiner**, James Cook University
- **212** Shifting cattle from grazing extensive pastures to floodplain pastures in the Northern Territory: Effect on rumen microbial communities, **Rosalind Gilbert**, DAF

Genetics

- **213** Accelerating genetic gain for fertility: The Northern Genomics Project, **Shannon Landmark**, QAAFI
- **214** Introducing new genomic evaluation BLUP in Brahman, **Gilbert Jeyaruban**, Animal Genetics and Breeding Unit
- **215** New diagnostic tools helping poll breeding for sustainable beef cattle production, **Imtiaz Randhawa**, The University of Queensland
- **216** Genetic control of fertility traits across species: variance in heifers' age at puberty explained by women's age at menarche genes, **Roy Costilla**, QAAFI

Agritech and smart farming

- **220** Extension activities to improve technology use on farm, **Eloise Moir**, DAF
- **221** A virtual fencing system did not affect weight gain or body condition of Angus Steers, **Cameron Ralph**, Agersens
- **222** E-Beef Smart Farming in Northern Queensland – improving pasture and business sustainability through adoption of the latest tools and technologies, **Anne Alison**, Southern Gulf NRM
- **223** Watching the grasses grow: using UAVs and satellites to monitor rangeland species composition, **Milou Dekkers**, The University of Queensland
- **224** FutureBeef: northern beef industry collaboration, **Nicole Sallur**, DAF
- **225** Ceres Tag – Development of a smart ear tag for livestock, **Greg Bishop-Hurley**, CSIRO
- **226** Assessing the potential for Automated Livestock Management Systems 4. Paddock Based Validation of Automatically Derived Dates of Birth, **Lauren O'Connor**, CQUniversity
- **227** Understanding percentiles for climate and grazing land management decisions through story-telling animation, **Grant Stone**, Queensland Department of Environment and Science
- **228** Calf Watch – Developing a system to remotely monitor calving and study calf loss in extensive situations in Northern Australia, **Tim Schatz**, NTDPIR

Farming systems

- **229** Intensive rotational grazing of improved pasture in the NT – update, **Tim Schatz**, NTDPIR
- **230** Benchmarking to improve long-term carrying capacity estimates for extensive grazing properties in Queensland, **Gabrielle Penna**, DAF
- **231** The re-emergence of dieback in pastures across Queensland, **Stuart Buck**, DAF
- **232** The Drought Map Sequence viewer: arranging rainfall and pasture maps for explaining drought situations, **Grant Stone**, Queensland Department of Environment and Science

Reproduction

- **238** Brahman and F1 Senepol x Brahman heifer performance in the NT, **Tim Schatz**, NTDPIR
- **239** Probability of visualising a corpus luteum with ultrasound in cycling heifers, **Jarud Muller**, DAF
- **240** Addressing vibriosis (bovine genital campylobacteriosis) diagnostics, **Alicja Tabor**, The University of Queensland

3:00pm Afternoon tea – Boulevard Auditorium Foyer

Session 4 – Boulevard Auditorium – Funding strategies for northern Australia
Chair – Peter Johnston

3.30pm **Directing levy funds through the producer consultation process - looking back on four years**
Irene Sobotta, MLA

4:00pm Managing and reversing the decline in funding for on farm R&D
Wayne Hall, DAF

4.30pm – 5.15pm Panel discussion
Our funding challenge and opportunities hosted by *Lea Diffy, Advance Qld*
Wayne Hall, DAF
Stephen Moore, The University of Queensland
Phil Cummins, QIC/NAPCO
Jed Matz, CRC For Developing Northern Australia

6.30pm **Conference Dinner and Awards Night**
Pre-dinner drinks. Recognition of Brian Burns (David Reid, DAF)
Presentation of NABRC Medals. MC and entertainment by Jean Kittson
Grand Ballroom, The Greek Club, 29 Edmonstone Street, South Brisbane

WEDNESDAY, 21 August 2019

Session 5 – Poster presentations

8.30am	Boulevard Auditorium Foyer	Room B1	Room B2	Room B3
Chair – Jill Alexander Farming systems	Chair – Don Menzies Agritech and smart farming, and Building human capability for a sustainable industry	Chair – Sarah Meale Nutrition, Animal welfare, and Genetics	Chair – Tim Schatz Reproduction and All things “P”	

Session 6 – Concurrent session – On farm R&D investments

9.25am	Boulevard Auditorium	Room B1	Room B3
Panel discussion Moderator – Marie Vitelli Managing plant toxins and animal health across N Australia <i>Johann Schröder (MLA)</i> <i>Chris McSweeney(CSIRO)</i> <i>Mary Fletcher (QAAF)</i> <i>Diane Ouwerkerk (DAF)</i>	Panel discussion Moderator – Steven Bray Managing and measuring the value of the northern value chains <i>Tim Moravek (DAF)</i> <i>Phil Holmes</i> <i>Ben Barrett (ANZ)</i> <i>Mark Harrison (QUT)</i>	Panel discussion Moderator – Peter O’Reagain Getting more from a sustainable feedbase <i>Gavin Peck (DAF)</i> <i>Kendrick Cox (DAF)</i> <i>Bron Christensen (TLN)</i> <i>Robyn Cowley (NTDPIF)</i>	

10.25am Morning tea – Boulevard Auditorium Foyer

Session 7 – Concurrent session – Today, tomorrow, technology

10.55am

Boulevard Auditorium

Chair – Bob Shepherd

Owen Keates, Hitachi Consulting

Room B1

Chair – Johann Schröder

Christine Purdy, MLA

Room B3

Chair – Raoul Boughton

David Johnston, AGBU

11.25am

Panel discussion

The data dilemma

Ed Charmley (CSIRO)

Don Menzies (CQU)

Ben Dwyer (ACBH)

Ben Hayes (QAAFI)

Panel discussion

Animal welfare for tomorrow

David Smith (Ceres)

Simon Kensit (AACo)

Dana Campbell (CSIRO)

Alan Tilbrook (QAAFI)

Panel discussion

Improving breeder herd efficiency

Nick Sangster

Tim Schatz (NTDPIR)

Ian McLean (Bush AgriBusiness)

Luis Prada e Silva (QAAFI)

12.25pm

Lunch – Boulevard Auditorium Foyer

Session 8 – Boulevard Auditorium – Getting into gear for a carbon neutral northern beef industry

Chair – Beverley Henry

1.25pm

CN30 R&D update and opportunities for Northern Australia

Doug McNicholl, MLA

1.55pm

Opportunities to reduce emissions – How the ERF could assist

Karen King, *Department of the Environment and Energy*

2.25pm

Emissions reduction fund

Geoff Murrell, Paraway

3.00pm

Afternoon tea – Boulevard Auditorium Foyer

Session 9 – Our industry, our R&D, our future

Chair – Ed Charmley

3.30pm

BeefLinks – a coordinated RD&E programme for WA beef

Phil Vercoe, UWA

4.00pm

New blood – new guns for the north, Alison Larard, DAF

4.20pm

Awards and Farewells from NBRUC2019, Andrew Gray, NBRUC 2019 Conference Chair

4.40pm

More from less – concluding remarks, Lee Fitzpatrick, NABRC Chair

6.30pm

NBRUC After Party

Southbank Beer Garden, 30ba Stanley Street Plaza

Theme: Viva BrisVegas!



THURSDAY, 22 August 2019

Field trip 1 – ACC Cannon Hill operations and Felons Brewery

7.30am	Depart Brisbane Travel to ACC Operations 117 Colmslie Rd, Cannon Hill QLD
8.15am	Tea and Coffee on arrival
8.30am	Introductory to site and induction (allocate to groups)
9.00am – 11.30am	<ol style="list-style-type: none">1 Overview of ACC Canon Hill operations and overview of production2 Tour of processing facility and packaging options for diverse markets3 Meat quality, food safety and the role of MSA in ensuring a quality product
12.00pm	Depart ACC Canon Hill
12.45pm	Arrive Felons Brewery New Farm
1.00pm – 3.00pm	Light lunch, beer tasting and tour of brewery
3.00pm	Participants are welcome to stay on at Felons for dinner and/or return to their accommodation independently

Field trip 2 – ACC Opal Creek feedlot and The University of Queensland, Gatton campus

6.30am	Depart Brisbane Travel to Plainlands – light breakfast
8.30am	Toowoomba rest stop
9.45am	Arrive feedlot
10.00am	Introduction to site, induction and overview (allocate to groups)
10.30am – 12.30pm	<ol style="list-style-type: none">1 Overview of feedlot and role of feedlot operations in maintaining supply into the value chain2 Tour of site facilities, pen operations, induction, feeding, stock management and dispatch3 Feed formulation and preparation – managing diet and environment for production gains
1.00pm	Lunch on site
2.00pm	Depart feedlot
3.30pm	Arrive UQ Gatton College <ol style="list-style-type: none">1 Inspection of research facilities (Queensland Animal Science Precinct) and presentations on ongoing research2 Darbalara visit3 Sunset BBQ – Old Homestead building
6.00pm	Return to Brisbane (eta 8.00 pm)

Field trips

Field trip 1 – ACC Cannon Hill and Felons New Farm

Date: Thursday 22 August

Time: Bus departs BCEC at 7.30am

Proposed schedule:

Depart BCEC and head to Australian Country Choice (ACC), Cannon Hill for the morning including a guided tour

12.15pm depart ACC and head to Felons New Farm for brewery tour and lunch.

3.30pm Make own way from Felons or stay on for the afternoon.

Cost: Tickets can be purchased for \$85 per person and includes the tour, morning tea and lunch. (subject to availability)

Field trip 2 – ACC Opal Creek and UQ Gatton Campus

Date: Thursday 22 August

Time: Bus departs BCEC at 6.30am

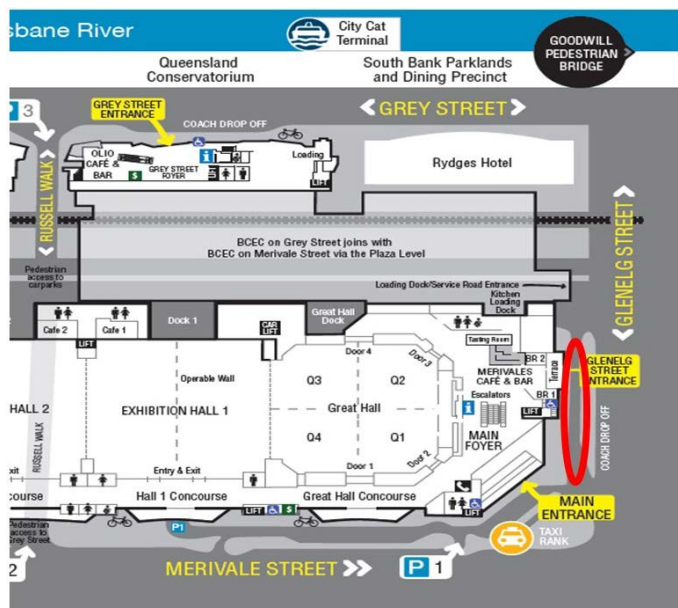
Proposed schedule:

Depart BCEC and head to Opal Creek feedlot (west of Toowoomba). Lunch will be provided at feedlot.

Return trip will include a stop at The University of Queensland Gatton Campus with a BBQ dinner and soft drink. A cash bar will be available for alcoholic drinks.

Please note: Anticipated arrival back at South Bank is currently 8:00pm.

Cost: Tickets can be purchased for \$85 per person and includes the tour, lunch and dinner. (subject to availability)



Bus departure point

The departure area for the field trip buses is the slip lane along Glenelg Street at the BCEC.

See the red circled area for reference.

The conference takes place on the Grey Street side of the building.

General information

Dress

A smart casual/business attire dress code applies for all conference sessions. Lounge suit/cocktail dress is requested for the Conference Dinner. The After Party is smart casual or the optional theme Viva BrisVegas!

Name badges

The wearing of identification badges is mandatory and will be required for admission to all sessions. A name badge will be provided at the registration desk upon your arrival.

Insurance

It is strongly recommended that delegates take out adequate medical, travel and personal insurance before travelling.

Wi-Fi

Casual wireless internet is available at no cost to visitors of the BCEC and is designed for web browsing and checking web based email. It is not designed for accessing VPNs or downloading large files. The speed is limited to 256k.

The network name is BCEC Link and does not require a password.

Liability disclaimer

In the event of industrial disruption or other unforeseen circumstances, the symposium organisers accept no responsibility for loss of monies incurred by delegates.

No-smoking policy

Delegates should be aware that smoking is not allowed in public buildings and many hotels and restaurants throughout Australia, including the symposium venue.

Registration desk

The NBRUC 2019 registration desk is located on the Boulevard level of the BCEC. Best entry is via Grey Street.

Registration desk hours:

Monday 19 August	4.30pm – 8.00pm
Tuesday 20 August	7.00am – 5.00pm
Wednesday 21 August	8.00am – 5.00pm

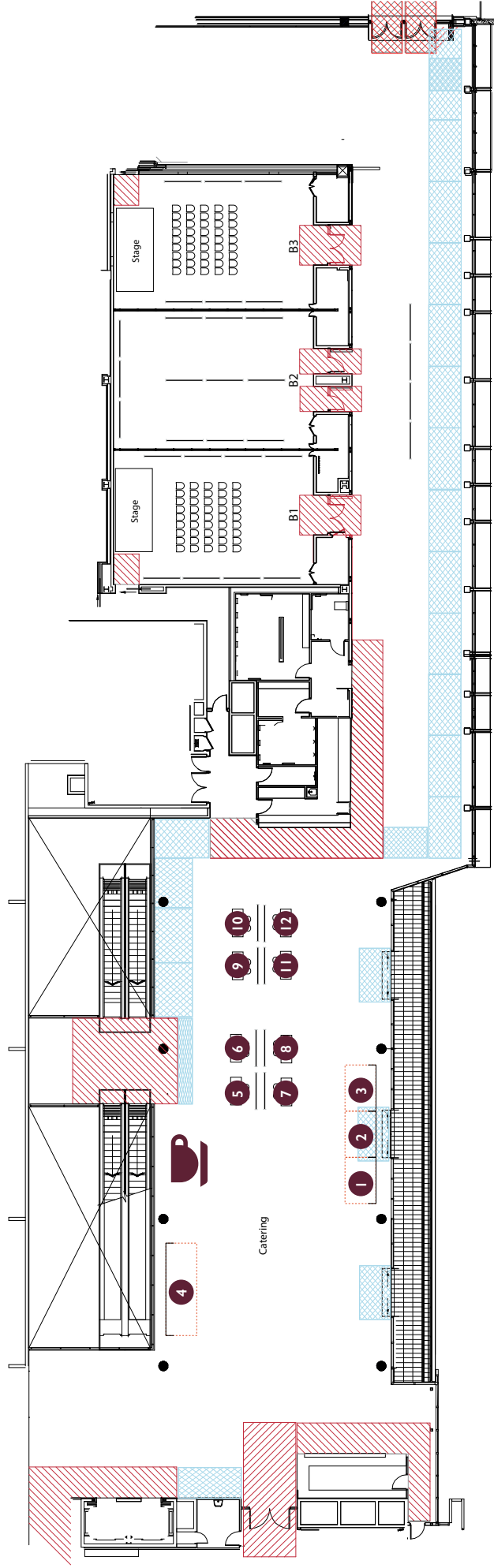
Speakers' preparation room

The speakers' preparation room is in the Convenors Office, located beside the registration desk. It will be open during the following times:

Monday 19 August	4.30pm – 7.30pm
Tuesday 20 August	7.00am – 5.00pm
Wednesday 21 August	7.30am – 4.00pm

All speakers are requested to check-in at the speakers' preparation room at least two hours prior to their session – or as early as possible – to ensure their presentation can be opened and loaded onto the central system. An audiovisual technician will be available to assist with presentations and will advise speakers of any further instructions.

Exhibitors



Exhibitors stands

- 7** Agrimix Pastures Progardes
- 8** Institute for Future Environments (QUT)
- 9** Olsson Industries
- 10** Meat & Livestock Australia
- 11** Neogen Australasia
- 12** The Four Seasons Company
- 1** DAF
- 2** North Qld Livestock Industry Recovery Agency
- 3** Clipex - Fencing & Stockyards
- 4** Angus Australia
- 5** Neogen Australasia
- 6** DataMuster
- 11** North Qld Livestock Industry Recovery Agency
- 2** Zoetis

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1. Taylor LF, Rodwell BJ. *Aust Vet J* 2001;79:682-685. 2. Morton JM, Phillips NJ, Taylor LF, McGowan MR, *Aust Vet J* 2013;91:517-524. 3. McGowan MR *et al*, In: Proceedings Northern Beef Research Update Conference 2013, 61-66. 4. MLA report B.NBP0382, 2014. 5. Taylor LF, Black PF, Pitt DJ *et al*. *Aust Vet J*. 2006;84:163-168. 6. Taylor L. *The Australian Cattle Veterinarian* 2010;57:14-28.

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Agrimix Pastures
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Poster program

Room: B1

Themes: Agritech and smart farming, and Building human capability for a sustainable industry

Presenting author	Poster number	Title
Christopher Materne	300	It's more cost effective to use irrigated pastures for hay than for grazing to grow beef in central Australia
Dionne Walsh	301	"Paddock Power": unlocking the secrets to sustainable and profitable intensification
Clare Atkins	302	Business Improvement Strategies of Pilbara and Kimberley Pastoralists
Clare Atkins	303	The "Twilight" effect – a new strategy for pastoral engagement
Stephanie Coombes	304	Discursive features of animal agriculture advocates
Debra Corbet	305(a)	Assessing the Potential for Automated Livestock Management Systems 1 Learning to Walk-over-Weigh
Nicholas Corbet	305(b)	Assessing the Potential for Automated Livestock Management Systems 2. Auto-drafting from Walk-over-Weigh
Don Menzies	306	Assessing the potential for Automated Livestock Management Systems 3. Using Walk-over-Weighing to estimate calf birth weight
Heather Jonsson	307	Peer to peer forage budgeting in the Upper Burdekin Rangelands
Tracy Longhurst	308	Development of Excel and Simple Record Keeping Workshops for Producers
Louise Newman	309	Legumes preferred by graziers in the Brigalow Belt
Louise Newman	310	Grazier practice change on legume pasture establishment and management
Nicole Sallur	311	Engaging with the FutureBeef eBulletin
Greg Bath	312	FutureBeef webinars - a platform for success
Roger Sneath	313	Grazier 'dry season' decision support tools
Megan Willis	314	Grazing Best Management Practice (BMP) enhances the James Cook University (JCU) veterinary students' final year beef experience
Chris Holloway	366	Out with old and in with the new: new methods for more accurate grazing land management (GLM) land type mapping.

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Michael Burgis	340	Improving the Leucaena Code of Practice to kill wild, ungrazed leucaena.
Joanne Campbell	341	Effect of various renovation techniques on rejuvenation of leucaena systems
Bron Christensen	342	Redlands for regions – improving in-paddock nutrition across northern Australia
Cameron Clark	343	Objective, robust, real-time animal welfare measures for the Australian red meat industry: Phase 1 validation
Natalie Connors	344	Changes to poll DNA testing for Australian beef cattle
Kendrick Cox	345	Tolerance of new stylosanthes lines to anthracnose
Kendrick Cox	346	Rejuvenating the tropical forages genebank to develop new pasture cultivars
Kendrick Cox	347	Seed production of some promising new grasses for seasonally dry areas of northern and central Queensland
Kendrick Cox	348	Plant evaluation within ACIAR projects can provide mutual benefits for northern Australia and regional neighbours

Christian	Duff	349	Understanding the influence of Angus genetics and associated genetic technologies in the Northern Australia beef industry
Vivian	Finlay	350	Black Basalt Country Rehabilitation
Kerry	Goodwin	351	Is your pasture and cattle performance linking with your FNIRS samples?
Russell	Gordon	352	Adsorbents for the sequestration of the Pimelea toxin, simplexin
Kirsty	Moore	353	Genetic and non-genetic effects gestation length on northern Australian tropically adapted beef breeds
Gabi	Netzel	354	Development of a mixed bacterial inoculum to detoxify the Indigofera toxin indospicine in the rumen – one step closer.
Gabi	Netzel	355	Risk of indospicine accumulation in bovine tissues from north-west Australia
Anthony	Parker	356	Calves walk less when placed with a social facilitator cow at weaning
Luis	Prada e Silva	357	Rumen efficiency and nitrogen preservation of cattle
Luis	Prada e Silva	358	Using live yeast to improve forage digestibility and performance of steers
Lee	Taylor	359	Impact of a single treatment of injectable doramectin post weaning in beef heifers and steers in central Queensland
Christie	Warburton	360	Assessing the value of whole genome sequence in selecting for age at puberty in tropically adapted beef heifers
Gene	Wijffels	361	Physiological and metabolic responses of grain fed cattle to moderate and high heat load.
Paul	Williams	362	Northern BIN Steer Project Update
Matt	Wolcott	363	The genetics of low birth weight and relationships with calf survival in tropically adapted beef cows
Melissa	Wooderson	364	Observations of tail rot in a Northern Territory breeder herd
Christopher	Materne	365	Supplementary feeding to improve MSA compliance doesn't pay?
Brianna	Maslen	369	Temporal changes in gastrointestinal microbiomes of beef cattle on feedlot placement.

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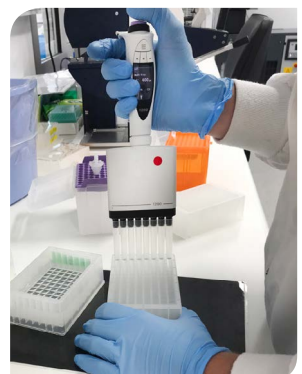
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Room: B3**Themes: All things “P” and Reproduction**

Presenting author	Poster number	Title
Jocelyn Coventry	315	Alice through the looking glass—comparison with beef cattle benchmarks
Robyn Cowley	316	Finding the ‘Sweet Spot’ for reproductive performance in north Australian beef herds
Rob Dixon	317	Blood P concentration depends on reproductive status in breeder cows
Rob Dixon	318	Blood P concentration may be highly variable in mixed-age breeder herds
Whitney Dollemore	319	Effect of age at first calving on incidence of calf loss in Brahman and Tropical Composite mobs in northern NT
Luke Finn	320	Plant Available Phosphorus Map of Queensland Grazing Lands- Stage 1
Tiago Silva	321	Phosphorus and zinc fertilization effect on the first season growth of three annual medic cultivars
Cyril Stephen	322	Design and development of a biological implant for long term intravaginal retention in cattle
Stephanie Coombes	323	The P Challenge - raising awareness of the plasma inorganic phosphorus (PIP) test for managing your herd
Joanne Campbell	367	Is mothering behaviour a potential measure of reproductive performance?
Alice Bambling	368	Implementing successful controlled mating programs in extensive beef herds

Room: Boulevard foyer**Themes: Farming systems**

Presenting author	Poster number	Title
Emily Barbi	324	Validating the Paddock to Reef herd management practice framework with empirical data: A vaccination example
Nicholas Brazier	325	Documenting the spread of Indian Couch (<i>Bothriochloa pertusa</i>) on Brian Pastures Research Facility
Samuel Crouch	326	Progress towards determining the feasibility of producing a sterile leucaena product
Daisy-May Denny	327	Does ground cover influence profit? Sky-high technology or sky-high thinking?
Gabrielle Lebbink	328	Modelling the current and potential spread of exotic grass <i>Bothriochloa pertusa</i> throughout sub-coastal Queensland
Timothy Moravek	329	A case for focusing on production systems over management practices to improve adoption rates.
Peter O'Reagain	330	Long term effects of different stocking strategies on sustainability and profitability in a variable climate
Joe Rolfe	331	Animal performance from psyllid resistance leucaena (Redlands)
Joe Rolfe	332	Preliminary animal performance for cattle grazing leucaena in timbered northern basalt country
Bernie English	333	Navua Sedge Control on the Southern Atherton Tablelands, Queensland
Nicole Spiegel-Janecek	334	Producer feedback on the production value of Indian couch in central QLD
Nicole Spiegel-Janecek	335	Managing native pastures in the Burdekin with NDVI handheld sensors
Nicole Spiegel-Janecek	336	Quantifying the production impacts of Indian couch in pastures
Dionne Walsh	337	Can fire be used to manage feathertop wiregrass in Mitchell grass pastures?
Dionne Walsh	338	Better landscape utilisation without more fences - can it be done?

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An international perspective for managing calf mortality - Using technology to help quantify calf loss

Raoul Boughton


University of Florida

For decades monitoring of animals in the wild has been difficult, original techniques were limited to direct observation, trapping, tagging, recapture and resighting. For example, John Audubon in 1803 was the first person to indirectly study wildlife using string tied around a bird (the Eastern Phoebe) leg, proving the same individuals returned each spring to the same location. With the advent of radar (1940) migration of birds could be detected from fixed towers. After WWII acoustic (1950) and Very High Frequency (1960) transmitting and receiving, devices could be placed on animals and telemetry or location of individuals derived from directional antennas. In the 1970's camera technology could be set up remotely to identify individuals (on film not digital!). The first PIT tags or RFID were being produced and used to estimated fish populations in the 1980's. In the 1990's a Global Position System became available for civilian use and wildlife biologists quickly deployed GPS on wide ranging animals, Black Bear, Grey Wolf and Elk. The ability to use the ARGOS or IRRIDIUM satellite communications allowed for data to be sent from anywhere in the world back to a central retrieval. Rapidly followed by Global System for Mobile Communications (GSM), or a wide area network. Today we have super highspeed data transfer with 4G and 5G data networks across whole countries.

Fantastic, now we can do anything we want, right? Wrong. The catch is all devices require a power source. It would be great to have a cell phone attached to your cow and continuously, measure steps, movement, temperature, grazing, resting, bite count, rumination and *the list goes on*. To do this with a cell phone with average power use for 1 year would require the equivalent of > 5 car batteries! Our limitations are development of tools to last in remote wilderness and extreme environments. Device size (battery) directly translates to trade-offs with transmission ability, frequency of data collection, and number of sensors. You possibly will have heard of the Internet of Things, a protocol working on a low power wide-area-network that allows for many hundreds to thousands of sensors to transfer data to central nodes over multiple miles. Coupled with a GSM network powerful possibilities exist to collect in the field and retrieve data at your desk.

Our lofty objective was to accurately measure the causes of calf loss on ranches in Florida directly on ranch. Hopefully, to allow partitioning of those causes to find solutions to improve current practices, focus future research efforts, and to help compensate ranches for potential losses. Calf loss from pregnancy diagnosis to weaning can range from a 3-4% up to 24% across Florida herds, with an average of a 10-13%. In most cases losses are unexplained and unquantified. To do this we have combined new and old technology to track birth events, cattle and calves, to allow rapid infield assessments of births and in combination with collection of dead calves for necropsy, a more clarified decision on cause of calf death.

In this fully collaborative ongoing study, ranchers, veterinarians, diagnostic centers and researchers are attempting to follow 3-4 herds/year of 100-200 head for three years from different locations to quantify the causes of calf loss. The causes will likely include mineral deficiencies, reduced immunocompetence, diseases, genetic disorders, poor maternal behaviors, and predation. Once calf loss is quantified, Florida cattlemen will help lead the nation in understanding calf loss, positioning the industry to make highly informed production decisions and implement measures to improve overall production and economic return. This research is funded by the Florida Beef Enhancement Board. In December 2016 field tests were successfully conducted on vaginal birthing inserts to allow almost immediate tracking of birth in remote locations where calf loss is highest. Feedback from those trials allowed improvements to be made in locating the birthing transmitters during early 2017. Although, sensor



resilience has been a problem through-out the project. During 2017 and 2018 the first three herds were fully tracked and observed. Calf loss ranged from 5-20% across these herds and causes of death many. Weak calf syndrome dominated calf loss, and causes of the syndrome ranged from dystocia, mineral deficiency to immune deficiencies. Bacterial communities collected at necropsy also suggest possible environmental exposure to bacteria known to cause abortions and septicemia, such as *Trueperella pyogens*. Interestingly, only one calf death could possibly have been associate with a predator.

This project would not have been possible without the development of new technology, and we are living in an exciting time as technology allows an increasingly fine lens of discovery of livestock in the field.

Putting more “value” into the value chain for northern production systems

Michael Crowley

Meat and Livestock Australia

Meeting and exceeding consumer expectations holds the key to improving the value of the red meat industry. In order to achieve this, the production system needs to evolve in order to capitalise on growing demand for your product and improving market access conditions. Pricing signals linked to proprietary brand specifications will create opportunities for the production sector to align production to meet the expectations of customers and ultimately consumers regardless of where they are in the world. However, how does the production system need to evolve to meet those expectations? Investments along the supply chain are creating opportunities for productivity, welfare and sustainability goals to be reached through the delivery of innovations that support a profitable and sustainable production system. Innovation has to consider the whole farm system and the value chain in order to achieve the greatest impact. Tools and technology are enablers that will support producers in making decisions through turning data into decisions, improving feedback, increasing transparency, reducing cost in order to meet productivity and profitability targets.

Today we will explore some of the key innovation investment areas along the supply chain and within the production system that are shaping the future.

The RDE&A for the northern beef industry – feast or famine.

Robert A. Karfs^A

^A Queensland Department of Agriculture and Fisheries

Introduction

Are we in the ‘best days’ for DAF Beef Research, Development and Extension (RD&E) or do you yearn for the good old days ... the golden era? A difficult question, which really depends on ones’ career path and experiences. Yet, I have a hypothesis that there have been three distinct phases of Beef RD&E in the Department over the last 40 or so years. This hypothesis is from a research manager’s perspective where I have questioned senior departmental colleagues, reviewed various grey literature, and from my own experiences in DAF since 2005 and in the Northern Territory Department since 1993.

Why is it important? Because culture, teamwork and an appropriate level of funding shape the quantity and quality of the workforce. This results in a steady flow of meaningful projects that make an impact to industry profitability and government priorities. Translating into innovation and professional papers that underpin staff training and personal development opportunities.

Discussion

My sense is that there was a ‘golden era’ of DAF Beef RD&E in the 1970s/1980s to around the late-1990s – Feast. In these times Government supported Agricultural Science had a high degree of prominence and associated RD&E was sustained, in part, by productivity and regional economic development and the National Brucellosis and Tuberculosis Eradication Campaign (or BTEC). From the late-1990s to about 2015 a leaner and disruptive time came on the back of New Public Management – Famine. From 2015, Beef RD&E activity has picked up once more – Feast. However, multiple re-organisations make it difficult to compare like for like over time. For example, currently DAF has 2146 employees, compared to a department that was all-encompassing with 6091 staff in the early 1990s.

Although more than 30 years apart, there are similarities between the two ‘Feast’ phases. Including longer-term investment by Government in Beef RD&E (e.g. 5-10+ years), through major programs such as the Queensland Alliance for Agriculture and Food Innovation (QAAFI), Reef Grazing Extension, and Drought and Climate Adaptability; combined with long-term investment by industry through Meat and Livestock Australia (MLA) and the MLA Donor Company.

What is different today from yesteryear is that there are (i) more women conducting Beef RD&E (in DAF), (ii) collaboration is king – where workforce skills are sourced from multiple organisations, (iii) competitive project grant processes are prevalent (iv) generally have smaller more integrated teams, and (v) agriculture is aided by modern communications and advanced technologies. Certainly the Digital Age will foster discovery and create efficiencies on-farm in the years to come (Langridge *et al.*, 2014; Torok and Holper, 2017), yet in contemporary times we still rely on the basic RD&E undertaken in the ‘golden age’ for driving innovation. What will we rely on in 30 years’ time?

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Torok, S. and Holper, P. (2017). Securing Australia’s Future: Harnessing Interdisciplinary Research for Innovation and Prosperity. CSIRO Publishing. Australia, pp.160.

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Grazed irrigated tropical pastures as a beef production system In the Pilbara

Kevin Bell

Pardoo Beef Corporation

Introduction

From the requirement to dewater active mines in the Pilbara, Rhodes grass has been grown under irrigation and supplied mostly to the north-western pastoral industry. Initial private modelling of expected fodder production under grazing by cattle gave optimism to a number of programs, utilising water from either artesian or shallow perched aquifers. Investment in this method of beef cattle production has gained impetus since 2013, either for finishing sale cattle or as a whole herd partial breeding and backgrounding program. The Pardoo Beef Corporation has developed a range of primarily Wagyu cattle programs involving both pastoral and irrigated pasture feed sources. Experience to date has yielded a growing body of information indicating that, impressive as the quantity of pasture may be, it is currently a relatively expensive fodder base with significant limitations posed primarily by digestibility and energy availability to ruminants. The statutory restrictions on pasture species permitted in rangeland areas of WA preclude the use of pasture species potentially higher in quality and more suited to grazing.

The current program: a summary

Maximum dry matter production of largely Rhodes grass pasture, generated by optimum water and fertiliser application. 40 and 50 ha pivots divided into 4 cells to enable some greater grazing control. Harvested is by direct grazing of cattle. Mobs are largely as dictated by cattle class. Grazing rotations variable but typically two to seven days grazing with regrowth intervals varied with season. Typically, slower in winter, more rapid in summer. Cattle numbers adjusted in line with observed and anticipated pasture growth rates. Tactical mechanical harvesting as hay, one cell at a time, is practised primarily to manage pasture surplus. Pasture managed under grazing may be very variable, but can be expected to yield of the order of 30,000 kg/year, CP 15%+, NDF 62%, DDM 60%, ME 8.6 MJ ME/kg as eaten. Of this utilisation may be 40% in the hot months October to March, and 60% in the remainder of the year.

Data obtained to date from a number of sources indicate that for cattle grazing Rhodes grass a liveweight gain of approximately 0.25% of liveweight/day is an expectation, *where cattle graze over the leaf Feed on Offer (FOO) range 2000 - 500 kg DM/ha*. This would confirm an NDF intake of approximately 1.2% of liveweight as a limitation. Cattle are monitored for trace element levels and worms. Copper, selenium and cobalt need to be supplied. Monitoring of worm egg counts in young cattle has indicated satisfactory worm management, even at in excess of 10 cattle/ha in summer. Caution is needed in winter with shorter pastures and more likelihood of larval ingestion. Rapid changes in pasture growth rates can prove very difficult to manage as preferred with adjusting of cattle grazing pressure. This factor operates throughout the year, but is more marked with greater consequences for pasture quality and quantity in summer. In winter supplementation can be employed to counter adverse effects on cattle performance and grass production due to inability to remove cattle in line with decreases in grass growth. Whilst these changes can be anticipated the magnitude and precise timing cannot.

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The impact of drought and growing resilience for beef producers

David G. Phelps

Department of Agriculture and Fisheries

Introduction

Northern Australia's beef producing regions are susceptible to drought. Production systems rely on rain-fed pastures, mainly on extensively grazed native pastures. The most immediate impact of drought are feed and water shortages necessitating reduced stock numbers or increased feed costs. Extended droughts lead to a decline in land condition, substantial destocking, reduced cash flow, depletion of financial reserves and can undermine industry confidence or an increase in poor mental health outcomes for individuals (Phelps and Kelly 2019). Grazing is the main economic driver in many regions. For example, grazing accounts for 45% of town-based business activity and 25% of economic output (Kelly and Phelps 2019) for central-western Queensland. The impacts of drought reach beyond the farm gate, leading to reduced employment opportunities, outmigration and reduction of services essential for both town and grazing businesses (Kelly and Phelps 2019).

Improving resilience

Resilience requires social, economic, and environmental systems to adapt, learn and transform (IPCC 2014, cited by Phelps and Kelly 2019). For beef producers, it can be improved by:

- Delivering services that enhance people's capacity to plan and make early decisions, tempered with the ability to respond to rapidly changing rainfall, markets and other external shocks
- Providing strong socioeconomic support structures and networks in beef producing regions
- Promoting good land condition to maximise the potential for growing feed in response to rainfall
- Building financial reserves based on sound economic business decisions and strong relationships with creditors
- Managing risk by balancing land condition and financial reserves through flexible stocking rates.

References

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Phelps, D.G. and Kelly, D (2019). Overcoming Drought Vulnerability in Rangeland communities: Lessons from central-western Queensland. *The Rangeland Journal* (early access online).

Pitching beef funding

Robert Faff

The University of Queensland

This masterclass has three related goals.

FIRST, it introduces the basics of the "pitching research" framework. This generic framework, fundamentally built on a simple template structure, is designed to succinctly and systematically convey all the important facets of a scholarly research project to a research collaborator (or mentor). In essence, attendees will take home a powerful tool that facilitates effective and meaningful interactive communication between two (or more) like-minded researchers.

SECOND, the masterclass will illustrate the pitching tool using a contemporary beef industry example, and, in this context, we hope to give a "taster" of a hypothetical *Shark Tank* experience.

THIRD, attendees are given some pointers on how the framework can lay a solid academic foundation for developing industry-relevant research, on a realistic path toward achieving meaningful *engagement and impact* outcomes. Finally, we (briefly) tie this all together in the context of applying for industry-linked research funding.

Directing levy funds through the producer consultation process - looking back on four years

Irene Sobotta

Meat and Livestock Australia

In 2015 MLA implemented a new Regional Consultation Framework for directing research, development and adoption (RD&A) investment for grassfed cattle and sheepmeat levies.

The aim of the Consultation Framework was to have a transparent, representative, cost-effective and systematic framework that underpins effective and relevant RD&A investment. The process was established to ensure national and regionally-relevant research, development and adoption priorities are identified to deliver optimum value back to grassfed beef and sheepmeat businesses and the red meat industry.

Today the process empowers grassfed beef and sheepmeat producers to directly influence the on-farm research, development and adoption activities their levies are invested in.

Regional consultation engages three national Research Councils: North Australia Beef Research Council (NABRC), Southern Australia Livestock Research Council (SALRC) and Western Australia Livestock Research Council (WALRC). Each of the councils have a sub-structure of regional committees ensuring broad representation of the interests of northern, southern and western grassfed cattle, sheep and lamb levy payers.

Over four years the process has guided the investment of grassfed beef and sheepmeat levies resulting in more than \$35M of RD&A projects. Since its inception the annual call process has seen more than 500 submitted preliminary proposals from 83 different applicant organisations resulting in almost 50 contracted projects set to advance industry.

Significant projects contracted with relevance for the northern beef industries use and management of the feedbase include the development of a sterile leucaena species for northern production systems, research into the biological control of weeds in northern Australia, and alternative nutrition supplements such as biochar to improve efficiency in ruminants. Substantial investment has also been made around animal wellness, productivity and profitability including projects covering the development of the ParaBoss platform for cattle, investigation into a single shot immuno-contraceptive for cattle, preliminary investigations into calf loss, and the development of the Northern Breeder Efficiency consortia in 2019.

Now heading into its fifth year, the annual investment call process will be evolving to better suit the needs of producers; ensuring regional issues are addressed without forsaking the broader goals of the red meat industry.

Managing and reversing the decline in funding for on-farm R&D

Wayne Hall

Queensland Department of Agriculture and Fisheries

When considering the issue of managing and reversing the decline in funding for on-farm R&D, the first question to consider is how much has on-farm R&D declined and over what time period – and are we also talking extension services? Unfortunately this first question is not easily answered as data at the appropriate scale (beef, on-farm, northern Australia) and over an appropriate time period is not easily accessed.

The best published data comes from ABARES (Millist *et al.* 2017) where they reported national rural expenditure for both extension (2005-2015) and R&D (2006-2015). What this report documented is that total national rural R&D expenditure has been increasing, extension expenditure has been generally stagnant, and that the private sector has been the main driver behind the increase in R&D expenditure (Fig. 1). What has declined is the funding by State and Territory governments for R&D.

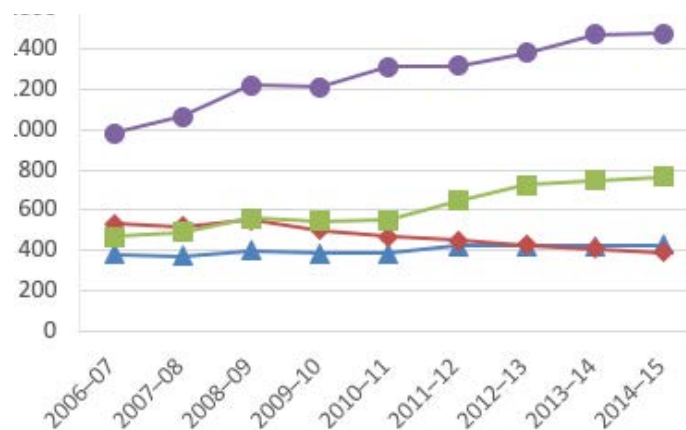


Fig. 1. National rural RD&E expenditure for the period 2006-2015: private sector (●), State and Territory governments (◆), university (■), Australian Government (▲)(Millist *et al.* 2017).

It is highly likely that the decline in State and Territory funding for R&D represents a decline in on-farm R&D. In terms of managing for and reversing this trend there are a number of factors that publicly funded researchers need to consider:

- Can they access private sector funding, and how are aligned are the R&D objectives of the private sector with those of State and Territory agencies, e.g. public versus private good.
- Forming alliances with universities who may have access to different funding sources.
- Engaging closely with industry and industry groups in both the identification of R&D priorities, the roll-out of projects and the dissemination of project findings.
- Ensuring that project outputs are converted to a dollar amount wherever possible.
- Marketing the benefits (economic, environmental, social) of their R&D to decision makers.
- Critically assessing and prioritising all concepts and proposals so only those that have a clear and compelling answer to the “so what” question are supported.

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Animal Welfare for the Future

Christine Purdy

Meat and Livestock Australia

Introduction

There are high and increasing expectations of industry in respect to the way livestock are treated and the wellbeing of animals in our care. Loss of community support is likely to not only influence consumer behaviour, causing market shrinkage but also lead to increased regulation. According to surveys carried out under Pollinate Consumer Research Report (MLA, 2018)¹ when asked the reasons for reducing red meat consumption, 10% of respondents said that the treatment of animals was the primary cause. This is up from <2% in 2010. Similarly, these surveys confirm that animal welfare is still the main reason for being a vegetarian. According to the Meat Industry Strategic Plan (RMAC, 2015)² the forecast value of risk associated with the loss of consumer and community support is \$3.9 billion to 2030. While cultural change of this type represents significant risk, it also provides an opportunity to drive the evolution of welfare practices in order to secure community/consumer support through a process of continuous improvement and product assurance. To support this evolution it will also be necessary to build industry capacity to provide the highest standards of animal care and track the welfare state of stock as they move through the supply chain.

Addressing the Issue

There is increased understanding of what constitutes 'wellbeing' for an individual production animal and our ability to evaluate welfare status has gone beyond that of simply looking at the husbandry and conditions under which animals are raised. Objective assessment of wellbeing using physiological and behavioural parameters, automated in many situations, is becoming easier and more specific to what is 'wellbeing'. Evaluation of wellbeing is already an expectation under other animal production systems and it is for this reason that we must actively engage across sectors in research, development, extension and adoption. We work with researchers and our counterparts in wool, pork, poultry and dairy to identify and develop new methods to improve welfare practice. We work with red meat producers, peak industry councils and other industry stakeholders to contextualise this new way of thinking and turn these new ideas into practical solutions. Then, as new techniques/technologies become available, the next challenge will be to share the message with community/consumers while simultaneously increasing the adoption of these new practices by producers.

Investment Priorities

Given the above, welfare research investment has assumed a two-speed approach. In the long term aimed at 'replacing' practices considered to represent poor welfare (particularly bloody and painful operations) and in the shorter term 'refining' those procedures or at the least mitigating the pain caused by them. 'Reducing' mortality, particularly in neonates and resulting from predation is also a focus for investment. As is the development of (preferably automated) methods to assess the wellbeing of livestock, in order to implement and demonstrate continuous improvement and potentially facilitate access to future premium markets.

1 Meat and Livestock Australia (MLA), 2018, Pollinate Consumer Research, MLA, Sydney

2 Red Meat Advisory Council (RMAC), 2015, Meat Industry Strategic Plan (MISP) 2020, RMAC, Canberra

Opportunities to reduce emissions – How the ERF could assist

Karen King

Department of the Environment and Energy

The Australian Government is committed to reducing its greenhouse gas (GHG) emissions by 26-28% below 2005 levels by 2030. The Emissions Reduction Fund (ERF) is a centre-piece of Australia's climate change policies. It provides incentives to reduce GHG emissions through economy-wide eligible activities, such as energy efficiency, waste management, revegetation, livestock management and savanna fire management.

Emissions Reduction Fund methods define eligible activities, the actions required for these to be compliant, and how emissions abatement can be quantified. Projects can register under ERF methods to commence a new management practice. Carbon credits are earned when projects demonstrate that they have undertaken the required actions and estimated the amount of emissions abatement consistent with the method.

In 2017, agricultural emissions in Australia represented 13.4 per cent of net national emissions. Of all agricultural emissions, 70.6 per cent, or 51.5 Mt CO₂-e, are a result of enteric methane emissions from livestock.

Ongoing research has identified potential opportunities to reduce livestock emissions by ten to more than thirty per cent. The Government is working to identify opportunities that are attractive to industry to reduce livestock emissions using emerging technologies. ERF methods provide opportunities to engage the sector in activities that earn carbon credits.

Emissions Reduction Fund

Geoff Murrell

Paraway Pastoral Company

The Government has worked closely with Meat and Livestock Australia (MLA) to develop the beef cattle herd management method. It is one of the methods under the Emissions Reduction Fund that creates a financial incentive for businesses to reduce greenhouse gas emissions.

MLA's analysis of the method found that improved management activities for a herd of 10,000 animals on pastoral lands could generate annual productivity gains of \$40,000 to \$80,000. These returns are in addition to revenue from the sale of carbon credits.

The ERF provides Australian businesses, including farmers and landholders the opportunity to reduce greenhouse gas emissions, while improving productivity, profitability and sustainability.

The majority of these projects are reducing emissions by storing carbon in trees or the soil, but a range of opportunities are available for farmers to participate in the Emissions Reduction Fund. For example, cattle producers are now able to reduce emissions from their livestock through a range of herd management activities.

Paraway's project was successfully contracted by the Clean Energy Regulator at the April 2016 auction to deliver carbon abatement over the next 7 years. Paraway is using the beef cattle herd management method, developed by the Department of the Environment, to reduce the CO2 intensity of the beef it produces. The project covers 10 properties in Queensland and New South Wales that run approximately 110,000 cattle.

The Emissions Reduction Fund method gave us a way to bring forward production improvements, allowing us to earn Australian carbon credit units, which we can sell. The project is aligned with our businesses land management and production objectives, it demonstrates our operating philosophy has environmental and profitability co-benefits.

Results to date:

In the first offset period 2016-17 we abated 22,604 tonnes of CO2 equivalent

In the second offset period 2017-18 we abated 39,238 tonnes of CO2 equivalent.

BeefLinks – a coordinated RD&E programme for WA beef

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There have been a number of recent developments that provide opportunities for the WA beef industry to develop and expand. These include using underground water for pivot irrigation and fodder production, alliances between northern and southern producers, as well as new market opportunities. However, the current industry practices and structures are not optimal for capitalising on these opportunities and there is a critical need for RD&E, particularly in the northern WA system. BeefLinks is a programme of work, funded through a partnership between The University of Western Australia and the Meat and Livestock Australia Donor Company, designed to address these needs.

The purpose of BeefLinks is to drive an integrated and complementary RD&E programme for northern and southern beef production systems across WA that achieves profitable, consistent and sustainable beef yields matched to consumer expectations. BeefLinks will achieve this by bringing together a partnership between industry (producers, grower groups, councils, mining companies), and the State Department (DPIRD). It will use this partnership to integrate RD&E activities across northern WA with the goals of increasing beef production from rangeland systems, better integrating rangeland and pivot irrigated feed, and growing value chain opportunities through alliances between northern and southern producers. Projects will be developed to achieve these goals under 4 project domains including; *Soils and Feedbase, Livestock Management, Water and Value Chain*. These 4 domains provide the structure to the programme and a framework to expand in the longer term. In addition to this, there will be a socio-economic project underpinning BeefLinks activities, examining the impact of changes to production systems on farm, in particular the impact the changes have on risk, stress, attitudes of producers (eg. mental health) and confidence.

One of the main objectives of BeefLinks is to develop practical and robust management practices to improve the transition of animals from the pastoral zone into southern backgrounding systems, as well as between grazing rangelands and forage produced under pivots, to build more certainty in year-round supply of in-specification cattle. A reliable supply of heavier cattle is central to developing confidence in producers and increasing the value of the WA beef value chain. In addition, R&D that helps to move the industry towards being carbon neutral by 2030 and producers to engage in the C economy will be a key consideration in the development of the new practical and robust management systems.

To achieve these objectives BeefLinks will co-ordinate and deliver on-farm trials, record cattle performance under enhanced management systems, develop practical guidelines for accelerated adaptation procedures and facilitate interactions along the supply chain to help industry extract higher value from the WA beef industry.

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200 The effect of insecticidal fly tags on cattle liveweight gain in the Douglas Daly region, NT

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Introduction

Buffalo flies (*Haematobia irritans exigua*) can cause irritation to cattle resulting in reduced growth, and the response to control measures in northern Australia has been variable (Bean *et al.* 1987). An experiment was conducted at Douglas Daly Research Farm, NT, to determine the effect of a new type of insecticidal fly tag (development tag number YT1625) on growth. The tags are a sustained-release, plastic ear tag containing a synergized formulation of Zetacypermethrin, an enriched S-isomer pyrethroid compound and Abamectin, which have not previously been used in combination on cattle.

Materials and methods

On 14/11/18, 118 one year old Brahman and Brahman cross bulls (average weight = 153 kg) were weighed and randomly allocated (stratified for weight) to either a CONTROL (n=59) or TAGGED (n=59) treatment group. Weight was recorded again the following day after an overnight curfew with no feed or water and the TAGGED group were each fitted with 2 fly tags while the CONTROL group did not receive any treatment for fly control. Each treatment group rotationally grazed a block of 8 x 6 ha uniform paddocks of Buffel pasture in such a way that they were never in adjacent paddocks. They were moved to a new paddock every 3 days and both treatments were always moved on the same day. Each time the treatments completed a rotation around the block of 8 paddocks they swapped blocks of paddocks so that TAGGED grazed the paddocks that had previously been grazed by CONTROL and vice versa. Both treatments had *ad libitum* access to mineral lick blocks and were managed in the same way throughout the study except for the fly tag treatment.

The cattle were weighed after an overnight curfew on 8/3/19 (after 16.1 weeks) and without a curfew on 9/5/19 (after 25.1 weeks) although the tags only have an approved control period of 16 weeks. Liveweight gain (LWG) was calculated using curfewed weights for the 16.1 week period and un-curfewed weights for the 25.1 week period. The average (LWG) of the two treatments over these periods was compared using a linear model adjusted for the initial weight covariate.

Results and discussion

After 16.1 weeks the average LWG of TAGGED was 9.8 kg more than CONTROL ($P < 0.001$) so the growth rate was 0.085 kg/day higher in TAGGED. LWG was 16.7 kg (0.095 kg/day) higher in TAGGED ($P < 0.001$) over the extended 25.1 week period. This was similar to the increase in LWG as a result of repeated spraying with insecticide reported by Bean *et al.* (1987) where treated cattle gained 14.7 kg more over 24.1 weeks (ie. 0.087 kg/day), and less than the 33 kg increase in LWG over 19 weeks (0.247 kg/day) from using diazanon ear tags reported by Spradberry and Tozer (1996).

The increase in LWG of 16.7 kg found in this study was worth \$48.43/head at the current cattle price of \$2.90/kg. The cost of the fly tags was \$7 per head so the return on investment from the TAGGED treatment was 692% assuming that the difference in weight gain persists through to the time of sale.

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20 | Do insecticidal fly tags protect against three day sickness?

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Introduction

Bovine Ephemeral Fever (BEF) or Three Day sickness is a viral disease that occurs commonly in cattle in northern Australia and is spread by mosquitoes and biting midges. It can cause economic losses through loss of weight, decreased milk production, lowered fertility of bulls (and hence lower pregnancy rates), abortion, delays in marketing and even death. This trial was conducted at Douglas Daly Research Farm, NT to investigate the effectiveness of insecticidal ear tags at preventing young bulls from becoming infected with BEF through repelling the insects that spread the disease.

Materials and methods

On 15/11/17, one year old Brahman and Brahman cross bulls were allocated to either a CONTROL or TAGGED treatment group. The CONTROL group did not receive any treatment for fly control while TAGGED animals were each fitted with 2 Python® fly tags on 15/11/17 and then on 28/2/18 the Python® tags were removed and replaced with a single Maxima® tag. This was done as Python® tags are rated for a period of 16 weeks and so would not be likely to repel flies for the whole wet season (Maxima® tags are rated for a period of 12 weeks). The two treatment groups grazed in separate paddocks approximately three kilometres apart.

Blood samples were collected from all animals on 15/11/17 and any animals found to have previously been infected with BEF were not included in the study (although they continued to graze with their group). This resulted in uneven numbers in the TAGGED (n=136) and CONTROL (n=108) treatments. Blood samples were collected again at 4, 9, 15 and 22.9 weeks and BEF virus neutralisation test (VNT) results were used to determine which animals had been infected (seroconverted) with BEF during the period between blood sample collections. The proportion of bulls seroconverting for BEF in the TAGGED treatment was compared to the CONTROL at 15 and 22.9 weeks using a 2-sample test for equality of proportions with continuity correction.

Results and discussion

After 15 weeks the infection rate in CONTROL (41%) was 21 percentage units higher than in TAGGED (20%) and this difference was statistically significant (Chi-square = 10.5, df = 1, p = 0.0012). After 22.9 weeks the infection rate was 24 percentage units higher in CONTROL (49%) than in TAGGED (25%) and the difference was statistically significant (Chi-square = 12.9, df = 1, p = 0.0003).

The fly tags were observed to be effective in repelling buffalo flies from the cattle during the study (*pers. obs.*) and while they resulted in a significant reduction in BEF infection, the fact that almost a quarter of TAGGED animals became infected means that they were not completely effective in repelling the main vectors of BEF transmission (ie. mosquitoes and midges) and hence in providing protection against BEF. Therefore they cannot be recommended as a preventative measure against BEF as there is a chance that important animals (eg. bulls in single sire mating groups) may become infected despite being tagged. The reduction in infection rate in TAGGED animals may have benefits such as higher liveweight gain, but this was not investigated in this trial due to differences between the paddocks in which the treatments grazed.

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202 A single-shot 5-in-1 vaccination at the time of dehorning/castration and prevalence of 'missing' animals at future mustering events

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Introduction

Vaccination against common clostridial diseases in cattle is recommended as being best practice husbandry and perceived by farmers and veterinarians to reduce disease and mortality. However, only 8% and 13% of stations within the Barkly and Katherine regions of NT, respectively, are estimated to administer either 5-in-1 or 7-in-1 vaccine to weaner cattle and means that significant proportions of young cattle are potentially at risk of infection by clostridial disease and production loss, particularly when husbandry procedures are performed (Cowley *et al.* 2014). This study proposed to investigate the mortality and economic benefits of application of administering a single-shot 5-in-1 vaccine under field conditions in the NT. Additionally, this study will also document mortality rates in recently weaned cattle managed under commercial conditions.

Materials and methods

Twelve cohorts of calves/weaners were observed on 10 stations in the Northern Territory for up to 10 months after branding/weaning.

Animals were enrolled at the time of castration/dehorning and systematically allocated to either 5-in-1 vaccination or control treatment groups on presentation at the branding cradle. The vaccinated group were injected subcutaneously with 2mL of Ultravac® 5-in-1 vaccine at the time of branding/dehorning. Sex (Male/Female), age class (Calf / Weaner), whether or not castrated and whether or not dehorned were recorded. For animals that were dehorned, whether or not the frontal sinus was exposed was also recorded. Likely mortality was based on whether or not an animal was present or absent at mustering events.

Regression analyses were conducted to assess the strength of association between explanatory factors upon outcome variables of interest. Where it was possible to combine data from multiple properties into a single analysis, the mob was included as a random effect. All analyses were conducted using Stata, version 13 (www.stata.com) with $\alpha=0.05$.

Results and discussion

Sufficient data were captured allowing 'missing' to be ascribed to 4,189 calves/weaners. On average, 6.6% (2.4-10.8% 95% CI) of all study mobs were identified as 'missing', with substantial variation between stations. A statistically significant positive association between time from procedure and 'missingness' ($P<0.05$) was determined. This finding suggests that this outcome is an inflated estimate of mortality and reasons other than mortality are represented. After adjusting for number and timing of mustering events one potential estimate of overall mortality was 4.1%.

There was no association between vaccination status and missingness within both males ($n=2701$; $P=0.88$) and females ($n=1474$; $P=0.62$). These findings indicate there was limited or no benefit in providing a single shot of 5-in-1 at the time of completing husbandry practices in the years and mobs involved in this study.

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203 Paraboss for cattle; a new web resource to assist with the control of ticks, flies, lice and worms of cattle

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Over \$350 million is lost annually by the Australian cattle industry due to parasitic diseases. Expertise in parasitology is being lost due to an aging workforce which has led to this Australian priority to consolidate existing knowledge. The Paraboss site will consist of around 300 pages of content, prepared by both national and international experts on tick, worm, fly and lice pests of cattle. The site will be targeted to the needs of producers providing an integrated pest management resource, as well as technical decision guides and advice on the effective control of parasites to improve cattle welfare in a cost effective manner. This MLA funded project is being created through a Queensland Government, University of Queensland and University of New England collaboration. The research outcome of the project will be an online information resource and tool for the regionally tailored management of cattle parasites. The site will also provide direction on programs to better guide pesticide use to lower the build-up of resistance.

204 Impact of dehorning and wound infection on live weight gain of beef calves

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Introduction

Over 3 million calves of all ages are dehorned annually in northern Australia, for reasons including: worker safety when handling cattle, reduced injury to other animals, less carcass bruising and to meet market specifications. Horn amputation is required beyond about two months of age after attachment of the horn bud. Although amputation dehorning is a regular surgical practice, there is almost no published data on incidence of post-operative infection and its impact on calf growth.

Methods

This experiment used 85 recently weaned Droughtmaster heifer calves aged 4-7 months at Spyglass Research Station in northern Queensland. Naturally polled calves served as controls, compared to calves dehorned by amputation; dehorning equipment was placed in an antiseptic solution between animals. All calves were ear-marked, branded and vaccinated at the time of dehorning. While grazing, each animal was monitored in the paddock with binoculars from a distance four times daily for 8 days after dehorning, twice daily on days 9-22, and then weekly until day 67. Treatment effect was measured by live weight change between dehorning and 67 days later and subjected to a two tailed t-test.

Results

Six of the 46 dehorned calves (13%) developed visually observable purulent wound infection, first observed on days 7-8 (n=5) and day 14 (n=1) (Table 1). Exudation resolved without intervention within a few days in each calf. Exposure of the sinus appeared to increase the risk of post-operative infection, but was not statistically significant (P=0.13; table 1). Amputation dehorning reduced live weight gain in the 67 days after surgery, with post-operative infection causing weight loss (P<0.01; Table 1).

Table 1. Effect of dehorning and wound infection on post-operative live weight change

Group	Control (polled)	Dehorned - No infection		Dehorned - Infected	
		No	Yes	No	Yes
Sinus exposed at dehorning					
n	39	20	20	1 (5%)	5 (20%)
Weight change (kg ± sd)	13.4 ± 8.5 ^a	7.9 ± 8.9 ^b		-5.7 ± 7.8 ^c	

Values followed by different superscripts within row differ significantly (P<0.01)

Discussion and Conclusion

The observed post-dehorning infection rate of 13% is consistent with the 11% reported by Fordyce *et al.* (2014). Though observable exudation from infections may resolve quickly, it is likely there is continuing infection and healing within the frontal sinuses. Infections have a substantial impact on the animal, reflected in much lower post-operative live weight gain than that caused by dehorning without infection. Preventing dehorning wound infection will improve welfare of calves

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205 Cattle tick research – realisTICK progress

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Introduction

Cattle ticks and the diseases they carry cost Australian cattle industries up to \$175m per annum in losses. During the Beef CRC (2005-2012), research to understand the immune mechanisms of host tick resistance was part of a large program which included the identification of new cattle tick vaccine candidates. Alternative(s) to the previous TickGARD vaccine were discovered with antigen mixtures showing promising levels of protection. Meat & Livestock Australia (MLA) has since supported trials to identify the most effective single antigens with full patents submitted February 2018. Researchers are also identifying tick host resistance biomarkers to simplify phenotyping for the development of genetic selection strategies. Biomarkers identified during Beef CRC research are also specifically under further evaluation.

Methods

Five tick challenge trials were undertaken in tick pens at the Queensland Animal Science Precinct, UQ Gatton campus testing 20 different antigens. Small groups of cattle (n=3) were vaccinated prior to infesting with tick larvae. After ~3 weeks, fully engorged adult female ticks were collected from each animal daily for on-going monitoring. The percent effectivity of each vaccine is determined by comparing the number of ticks, the weight of eggs and the percentage of larvae emerging from the eggs – in comparison to the ticks collected from unvaccinated cattle. Previous samples collected from a Beef CRC Santa Gertrudis trial (Piper et al., 2017) were screened to identify alleles in the CD45 gene, previously shown to differentiate tick susceptible and resistant cattle (Constantinoiu et al., 2018).

Results

A total of nine antigens were identified with individual vaccine efficacies against tick challenge ranging from 35-66%. Specific differences have been identified in the CD45 gene between populations of tick susceptible and resistant cattle.

Discussion/Conclusions

Tick vaccine trials are currently screening the top 4 antigens as cocktail vaccines aiming for combined efficacies of 80-85%. Further research is underway to determine if CD45 differences are specific for tick resistance or susceptibility across different breeds of cattle.

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206 Grazing weaners on oats: the effect of compensatory gain on productivity and profitability

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Introduction

In central Queensland, it is common industry practice to graze growing cattle on forage oats, before returning them to a grass pasture, despite the potential for compensatory gain. Producers have indicated they do not understand compensatory gain and its impact on profitability (Bowen and Hopkins 2016). The objective of this study was to demonstrate the effects of compensatory gain on productivity and profitability resulting from grazing weaners on oats in the dry season followed by grass pastures in the wet season.

Methods

An On-farm trial (OFT) on a commercial producer co-operator's property at Taroom, central Queensland was conducted over two years; 2016 dry season - 2017 wet season and 2017 dry season - 2018 wet season. Each year, a group of mixed Santa Gertrudis and Brangus weaner steers were stratified on weight and randomly allocated to two mobs resulting in similar average starting mob weight (Year 1: 307 kg; oats n=64; grass n=63. Year 2: oats 270 kg, n=75; grass 268 kg, n=74). Cattle were weighed on and off their starting paddock (oats or buffel grass pasture) in the dry season and then grouped together to graze grass as one mob for the subsequent wet season. Cattle were weighed off the grass pasture at the end of the wet season.

Results and discussion

During the dry season in both years, cattle that grazed oats had a significantly ($P<0.05$) higher average daily weight gain (ADG; kg/head) than those grazing grass (Year 1: oats 1.05 vs grass 0.95; Year 2: oats 1.07 vs grass 0.64). However when grazing grass in the subsequent wet season, cattle that had come from dry season grass experienced compensatory growth with significantly ($P<0.05$) higher ADGs than the cattle that came from oats (Year 1: oats 0.92 vs grass 0.97; Year 2: oats 1.03 vs grass 1.16). In Year 2 there was a significant ($P<0.001$) difference in the weight of oats and grass cattle at the end of the oats season (oats cattle on average 42.1 kg heavier) but this was reduced to a significant ($P<0.001$) difference of 29.3 kg after 98 days grazing wet season grass. The difference in the weight of cattle at the point of sale was reduced due to compensatory gain, which eroded the liveweight and economic benefit provided by the forage oats crop. Whole-farm economic analysis showed that feeding weaners oats and returning them to grass before sale was not a profitable venture. This supports previous research on the use of oats over a longer time frame and confirms that feeding forage oats to cattle at any point in their lifetime reduces the profitability of the beef enterprise compared with a grass-only grazing system (Bowen and Chudleigh 2018).

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207 Measurements of feed efficiency in cattle fed protein-deficient diets

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Introduction

Improvements in feed efficiency (FE) can lead to significant economic benefits and reduce the environmental footprint of any beef cattle production system. Animals selected for FE on high-protein (HP) diets are expected to perform as efficiently on low-protein (LP) diets. Thus, the objective of this experiment was to determine the agreement between FE rankings of beef cattle fed a HP and a LP diet.

Methods

In a completely randomized block design, thirty Brahman steers (398 ± 24 kg liveweight) were individually fed for two 70 day periods, with diets supplying either 70% (LP) or 100% (HP) of their rumen degradable protein requirements. Dry matter intake (DMI) and average daily gain (ADG) were measured, while feed conversion ratio (FCR), gain to feed ratio (G:F), residual feed intake (RFI) and residual gain (RG) were calculated. Kappa analysis and Pearson correlation coefficient were used to determine the agreement between the different FE measurements of both diets.

Results

There was no agreement or correlation between steers fed a LP and HP diet for any studied performance or FE traits (Table 1). RFI was strongly correlated with DMI (0.94, $P < 0.01$) and RG was strongly correlated with ADG (0.91, $P = 0.01$) for steers fed LP diets.

Table 1. Descriptive statistics and agreement coefficients of feed efficiency traits in different diets.

Items ^A	Diet LP				Diet HP				Kappa	<i>r</i>
	Mean	Min	Max	SD	Mean	Min	Max	SD	(P-value)	(P-value)
DMI (% LW)	1.94	1.62	2.3	0.15	1.69	1.04	2.01	0.2	-0.07 (0.55)	0.36 (0.06)
ADG (kg)	0.92	0.38	1.47	0.24	1.12	0.64	1.57	0.23	0.01 (0.98)	-0.05 (0.80)
FCR	9.46	5.6	23.57	3.17	7.65	5.71	10.53	1.35	-0.09 (0.44)	-0.10 (0.62)
G:F	0.113	0.042	0.179	0.025	0.134	0.095	0.175	0.022	-0.11 (0.40)	-0.13 (0.53)
RFI	0	-1.32	1.54	0.60	0	-1.47	1.52	0.73	-0.06 (0.68)	0.30 (0.13)
RG	0	-0.61	0.53	0.21	0	-0.34	0.31	0.18	-0.09 (0.44)	-0.07 (0.72)

Discussion

The present study confirms the large individual variation in FE in the Australian beef cattle herd. Negative kappa values indicate poor agreement in ranking of the animals on different diets. These results suggest that different physiological mechanisms are responsible for FE regulation in each diet; thus, appropriate diets targeting each scenario must be used when selecting animals for FE.

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208 Estimating diet nitrogen use efficiency from isotopes of tail hair in cattle

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Introduction

Cattle grazing tropical rangelands often have to depend on N-deficient pastures during prolonged dry seasons. Thus the ability of individual animals to best utilize the available diet N (i.e. N use efficiency; NUE) is likely directly related to performance. As tail hair grows amino acids are incorporated into hair proteins, and the relative abundance of the ¹⁵N and ¹⁴N isotopes ($\delta^{15}\text{N}_{\text{tailhair}}$) reflect a number of factors, including diet. Animals with higher NUE may have lower $\delta^{15}\text{N}_{\text{tailhair}}$ apparently because of lower urinary N excretion (Cantalapiedra-Hijar et al. 2015). Estimation of NUE from tail hair has obvious advantages for practical on-farm sampling. This study evaluated whether NUE was related to $\delta^{15}\text{N}_{\text{tailhair}}$ in *Bos indicus* cattle typical of northern Australia.

Methods

Twenty-eight Brahman steers ($398 \pm 7\text{kg}$) fed a low-protein diet (70% of required RDP) for 70 days were classified as High (H), Medium (M) or Low (L) based on measured Residual Gain (RG) and Residual Feed Intake (RFI). NUE (g retained N/100 g digested N) was measured in metabolism crates. Tail hair was sampled on day 70, cut into 10 mm segments, and analysed for $\delta^{15}\text{N}_{\text{tailhair}}$ by mass spectroscopy.

Results

Fig. 1. shows that steers classified as more efficient by RG criteria ($P=0.02$) had lower $\delta^{15}\text{N}_{\text{tailhair}}$ (H vs L, $P=0.02$). However the steers were not classified by RFI criteria ($P=0.80$). Fig. 2. shows that there was a significant ($P=0.02$) relationship between NUE and the $\delta^{15}\text{N}_{\text{tailhair}}$ of H and L steers.

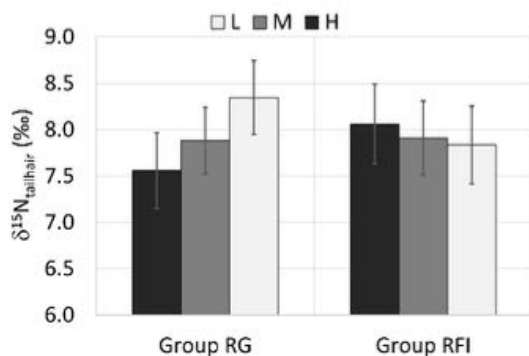


Fig. 1. $\delta^{15}\text{N}_{\text{tailhair}}$ of steers in groups classified according to residual gain or residual feed intake.

Fig. 2. $\delta^{15}\text{N}_{\text{tailhair}}$ correlated with nitrogen use efficiency of High (□) and Low (●) steers

Discussion

The results demonstrate that NUE could be estimated from $\delta^{15}\text{N}_{\text{tailhair}}$ with reasonable accuracy. These preliminary results indicate that it may be possible to estimate NUE and identify animals which are more efficient while requiring only simple non-invasive sampling on-farm.

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209 Supplementation effects on growth and fertility in lactating *Bos indicus* cows in the Katherine region, Northern Territory

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Introduction

This paper summarises the results of a producer initiated study, completed under the MLA Producer Innovation Fast-Track program, investigating the benefit of feeding molasses-based supplements to improve profitability of different classes of cattle in the Katherine region. Typically, in areas close to sugar mills, molasses-based supplements are fed to cattle to address nitrogen and phosphorus limitations during the dry and wet seasons, respectively, while also supplying an energy supplement. This would potentially increase overall profitability if significant, cost effective improvements in reproductive performance or reduced age at turnoff were observed. Some of these supplements also include additives that alter the dietary cation-anion difference (DCAD) to aid mobilisation of calcium, phosphorus and other nutrients.

Materials and methods

On 12-June-18, 532 pregnant cows, expected to calve between Oct-18 and Feb-19, were randomly allocated to two groups. These groups were managed similarly except for their supplementation, either receiving a loose-lick mineral supplement (LLS) [n=255, body condition score (BCS) = 3.9 and Liveweight (LW) = 441 kg] or a molasses-based supplement (MOL; Ultralix) (n=277, BCS = 3.9 and LW = 449 kg). The two supplementation groups grazed in adjacent, native pastured paddocks on Stapleton Station, NT until the weaning muster on 24-April-19 when BCS, lactation and pregnancy status were assessed, LW recorded, and foetal age estimated. Stocking rates were 3.8 LSU per km² of watered area (using a 3 km grazing radius). *Ad libitum*, year-round access to supplement was available with LLS supplement intakes averaging 196 g/head.d during the dry season (12-June to 31-Oct-18) and 60 g/head.d in the wet season (to 18-April-19) and MOL supplement intake averaged 1.26 kg/head.d across the dry and wet seasons. Different Ultralix breeder range products (Breeder 4, Breeder 6 and Breeder XP) were fed during the early-dry, late-dry and wet seasons, respectively. Wet-season loose lick (same as LLS) was also provided to MOL cows between 31-Oct-18 and 18-April-19, which was consumed at 6 g/head.d.

Results and discussion

Sufficient data were captured to ascribe reproductive performance outcomes to 423 individual cows with an average weaner production of 145.3 kg/retained cow across both groups.

The observed improvements in BCS (MOL 3.33 vs. LLS 3.38; P=0.04) and LW (MOL 412.6 vs. LLS 396.7 kg; P=0.01) of lactating cows in the MOL group did not correspond with either an increase in percentage of cows pregnant while lactating (MOL 32.1 vs. LLS 34.3%; P=0.66) or a reduction in calf loss (MOL 13.1 vs. LLS 12.9%; P=0.97). The average LW of weaners was also similar (MOL 167.9 vs. LLS 166.2 kg; P=0.70). The average LW of non-lactating MOL cows tended to be heavier than LLS although it was not statistically significant (MOL 489.4 vs. LLS 461.6 kg; P=0.11).

The lack of reproductive response to the energy supplement is not easily explained. However, the slight increase in body reserves indicates only a small improvement in energy supply. It is also speculated that the DCAD may have exceeded the desired range, having a deleterious effect.

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210 Desmanthus: A tropical legume for reducing methane emissions in Northern Australian beef cattle

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Introduction

Desmanthus is a tropical pasture legume that can persist in semiarid clay soil regions with a productivity of about 30% legumes and 70% grasses. Progardes Desmanthus has been sown in about 35,000ha of commercial paddocks across principally Queensland but also northern New South Wales and the Northern Territory. The legume showed promising results in decreasing methane emissions *in vitro* and improving animal performance *in vivo*. The objective of this study was to investigate the effects of supplementing incrementally beef cattle with two species of Desmanthus (*D. leptophyllus* cv. JCU1 and *D. bicornutus* cv. JCU4) on methane emissions and estimate the carbon credit unit that a northern Australian farm could earn by using Desmanthus as a supplement.

Methods

Fourteen Droughtmaster steers were allocated to JCU1 (N=7) and JCU4 (N=7) Desmanthus cultivars. Basal Rhodes Grass (*Chloris gayana*) was offered to the animals plus fresh Desmanthus at 0, 12, 24, 36 and 48% of dry matter in each period. Every period lasted 42 days and methane production was measured by open-circuit gas exchange in the last 2 days of every period.

Results and Discussion

Results showed no differences in methane emissions between Desmanthus cultivars. However, a significant decrease in CH₄ emissions with increasing level of Desmanthus ($p=0.0144$) was observed. The decrease in methane followed a linear pattern (Fig. 1) and showed a CH₄ reduction of about 12% for 48% Desmanthus inclusion.

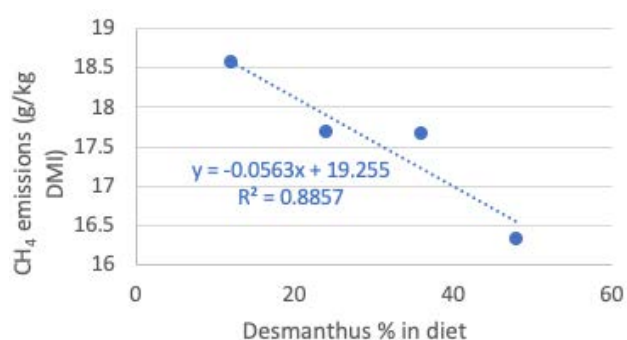


Fig 1. Preliminary results of methane emissions from tropical beef cattle in function of the Desmanthus treatment (12, 24, 36, 48%).

Conclusion

The study demonstrated that these two cultivars of Desmanthus can reduce *in vivo* methane emissions from cattle. An average beef farm in Northern Australia of 1,576 head would \$4,785/year of Australian carbon credit units (ACCU) with 48% Desmanthus inclusion (assuming a global warming potential of 25 for methane, a CH₄ emissions per animal of 200g/d and an average price of \$13.87/ACCU).

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2 | Progardes Desmanthus – an update

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Introduction

Some 35,000 ha has now been sown to Progardes™ Desmanthus since its launch in 2012. It has been sown primarily across Queensland, but also into northern New South Wales and the Northern Territory. The targeted soil types have been Vertosols and related, mainly neutral to alkaline clay soils in semiarid environments. Progardes is a blend of typically 5 PBR registered varieties of Desmanthus (cv JCU 1-5).

Update information

Four new cultivars, JCU 6-9, are in seed increase. Agrimix Pastures and James Cook University are evaluating and selecting new accessions of Desmanthus, particularly those that have persisted through drought and grazing. Many of these are being evaluated across inland northern Australia through a CRC supported project. Cultivar JCU 2 has recently been shown to access soil moisture to >1.2 m and be productive in NSW. A Desmanthus breeding program that includes intraspecific and interspecific crosses is well advanced, with crosses undergoing field evaluation. There is interest also in other species to complement Progardes including new varieties of *Stylosanthes*, *Clitoria* and *Centrosema* that show considerable promise.

Research regarding new advanced strains of Rhizobia specifically for Progardes are also being undertaken, including isolating effective strains from the native legume *Neptunia* and from adventive and cultivated Desmanthus plants. Nodules from these plants have been collected from a wide geographic area across northern Queensland, particularly from semiarid neutral to alkaline soils. It's expected that these new strains from the native environment will be resilient to both abiotic and edaphic environmental factors and particularly to heat and alkalinity. Already some new strains have scored better in terms of plant growth than the existing recommended commercial inoculant.

Investigations regarding *in vitro* and *in vivo* antimethanogenic properties of JCU Desmanthus cultivars have or are currently being undertaken. Formal and informal producer paired paddock trials are investigating nutritive attributes and botanical composition of pastures with and without Progardes™. This work is expected to confirm liveweight gains in the order of an additional 40 kg/head per year over grass alone pastures and confirm the value of sown legumes for beef cattle production systems.

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212 Shifting cattle from grazing extensive pastures to floodplain pastures in the Northern Territory: Effect on rumen microbial communities

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Introduction

The majority of beef cattle production in northern Australia is extensively grazed on unimproved pastures and aged cows are often preferentially culled from breeding herds, as they are at increased risk of mortality. The sale of these surplus to breeding requirement cows (culled cows) is often an important contributor to the overall revenue generated by the beef enterprise. Aged cows are often low in body condition at the time of culling and relocating them to the higher-quality floodplain pastures to increase liveweight and improve carcass characteristics has been identified as having the potential to increase profits.

Methods

The effect of relocating cows that have been grazing low-quality native pastures to higher quality floodplain pastures on the rumen microbiome was investigated in 41 cows sourced from either commercial (COM) properties (32 cows) or Beatrice Hill Research Station (BHRS) (9 cows). Rumen fluid samples obtained from animals at induction to the floodplain (day 0), and again 34 and 137 days after grazing the flood plain were used for microbial diversity profiling (barcoded V3-V4 16S rRNA gene amplicon) using the Illumina MiSeq sequencing platform.

Results

Rumen microbial diversity changed significantly during the trial, with cows sourced from COM properties having lower microbial diversity than the BHRS cows, when first introduced to the floodplain. After 34 days of co-grazing on the floodplain pastures, the microbial diversity measures had increased for the COM cows and were not significantly different to the BHRS cows. Following a further 103 days of grazing floodplain pastures, the extent of microbial diversity and overall rumen microbial community composition had converged.

Discussion/Conclusions

The convergence of microbial populations indicated the transfer of rumen microbes between co-grazing, mature cows. The study also indicated that diet is one of the primary drivers in determining the relative taxonomic composition of the rumen, even in a relatively uncontrolled, extensively grazed feeding system, such as the floodplain pastures of the Northern Territory.

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213 Accelerating genetic gain for fertility: The Northern Genomics Project

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Introduction

Cow fertility is a major driver of profitability of beef production in northern Australia. The “Northern Beef Genomics”, is a large project that will provide producers with tools to improve fertility of their herd. By developing a relatively-inexpensive genomic (DNA) test and producing genomic breeding values for genetic merit of tropical beef cattle of all breeds, crossbreds and composites, rapid selection decisions for both bulls and heifers should be achievable. That is, from a tail hair sample on a bull or heifer calf, it will be possible to predict with useful accuracy the value of the genes they carry for traits such as ability to cycle and conceive during lactation, approximate age at puberty in females, and other fertility traits. The project will collect data and genotypes for at least 30,000 cows.

Methods

Fifty four collaborator herds from across northern Australia are participating in the project. The first round of data collection is complete, with 22,267 heifers across a wide range of breeds, crossbreds and composites ovarian scanned, and recorded for cycling/not cycling (a proxy trait for age at puberty, and correlated to lifetime productivity of cows, Corbet *et al.* 2018), as well as weight, body condition score, hip height, fly lesions, and tick scores, Table 1. These first measurements are assessed when an estimated 50% are pubertal (1.0-2.5 years of age.) Tail hairs have been taken from all heifers for genotyping. In addition to the fertility traits being measured, weaners are being temperament scored by use of a pen/pound method to develop a DNA test for temperament. We have currently scored over 1600 weaners for temperament. In a preliminary analysis with 15,000 heifers, we used the genomic data to estimate heritability of the traits (correcting for heterosis and breed effects).

Table 1. Number of records for each trait in the Northern Genomics Project

<u>Trait</u>	<u>Number of females</u>
Ovarian Scanned	22,267
First Pregnancy Test	7,333
Second Pregnancy Test	1,094
Fly Score	7,693
Tick Score	2,626

Results and Discussion

Preliminary analyses has given encouraging results for the heritability of key traits, Table 2. The heritability of cycling/not cycling by 600 days is sufficiently high that good selection responses would be possible once genomic breeding values are available for this trait.

Table 2. Heritability estimates for selected heifer traits in the northern beef genomics project

	Pubertal at 600 days	Live weight	Hip height
Heritability ± standard error	0.42 ± 0.05	0.50 ± 0.04	0.58 ± 0.04

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214 Introducing new genomic evaluation BLUP in Brahman

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Introduction

Single-step Genomic BLUP (SSGBLUP), using information from pedigree, phenotypes and genotypes has been implemented for the genetic evaluation of Brahman cattle in Australia (Johnston *et al.* 2018). SSGBLUP combines the genomic relationship matrix (G) for genotyped animals with the pedigree-based relationship (A) for non-genotyped animals. An important implementation step is to quantify the extent of increase in predictability of SSGBLUP over the traditional pedigree BLUP (NRMBLUP). A forward cross validation method proposed by Legarra and Reverter (2018) was used in this study to compare SSGBLUP and NRMBLUP EBVs to predict future progeny phenotypic differences.

Materials and methods

Traits studied were 600 day weight (FWT), scan eye muscle area in bulls (BEMA), and scrotal circumference (SC). Table 1. summarises the number of animals with phenotypes and genotypes for each trait. EBVs from 'full' and 'partial' data sets were generated. The full data set included all relationships, genotypes and phenotypes of animals born up to November 2018. For the partial data set, phenotypes of animals born after December 2014 were removed and the data for animals removed were used as the 'validation data set'. The SSGBLUP and NRMBLUP analysis was performed separately for the full and partial data sets. The EBVs were predicted for animals in the validation data set. Forward cross validation analyses was used to compute the correlations to calculate the increase in predictability between EBVs using full and partial data for animals in the validation data.

Results and discussion

Heritabilities used in the prediction for FWT, BEMA and SC were 0.48, 0.21 and 0.44, respectively. The increase in predictability for SSGBLUP compared to NRMBLUP ranged from 11 to 19% for genotyped animals in the validation set and ranged from 0 to 4% for non-genotyped animals. As expected, the advantage in predictability of using SSGBLUP (compared to NRMBLUP) was higher for genotyped animals than non-genotyped animals. Ability to predict the future phenotypic differences was influenced by the number of genotyped animals in the evaluation and the heritability of the trait.

Table 1. Increase in predictability for SSGBLUP over NRMBLUP for genotyped Brahman cattle.

Trait	Number of records		Number of genotyped animals (validation set)	Correlations		Increased in predictability (%)
	full	partial		SSGBLUP	NRMBLUP	
FWT	142,789	120,467	3,076	0.63	0.53	19
BEMA	17,064	12,321	1,189	0.40	0.34	18
SC	35,445	26,852	1,305	0.63	0.57	11

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215 New diagnostic tools helping poll breeding for sustainable beef production

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Introduction

Management of horns in beef cattle has major economic and welfare impacts, and therefore, breeding for naturally hornless (polled) cattle is widely practiced. Poll breeding can be significantly accelerated by using DNA diagnostic tools (Prayaga 2007), and the Australian beef cattle industry has adopted the available DNA poll testing assays, which are generally successful. However, issues of applicability in *Bos indicus* cattle has arisen due to a more complex mode of inheritance of the horn phenotype. This study has investigated these limitations and further optimized the poll gene testing to increase accuracy and informativeness across all breeds. We also investigated if polled genetics were different than horned animals for beef production.

Methods

Current molecular poll testing (CPT) tools, i.e., microsatellite and SNP based assays, were compared for their efficiency and accuracy. Both types of CPT were limited by higher rates of prediction failures, especially in Brahman and Brahman cross-bred cattle. We subsequently investigated genotypes using 10 SNPs recently identified in the poll gene region (Medugorac et al. 2012) to develop a more accurate prediction of polledness, with an emphasis on tropical breeds. In addition, estimated breeding values (EBVs) were compared between the poll and horn cohorts across breeds for several beef traits regarding production and reproduction.

Results and discussion

An optimized poll testing (OPT) prediction based on 5 SNP markers present on most current SNP chips was developed and was shown to accurately predict genetic variants associated with the predominant poll types (Celtic and Friesian) in several beef cattle breeds including Brahman. Comparison of EBVs of polled and horned cattle suggested that for most of the production and reproductive traits, average EBVs were very similar and any significant differences were of very small effect size. We conclude that by utilising the refined OPT, the frequency of genetically polled beef cattle can be rapidly increased without any compromise in production or performance to enhance animal welfare and sustainable beef production.

Acknowledgements

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216 Genetic control of fertility traits across species: variance in heifers' age at puberty explained by women's age at menarche genes

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Introduction

Fertility traits are of paramount importance for humans and cattle. In humans, they greatly impact population growth. In cattle, they are one of the main industry profit drivers. We investigated the effect of variants in genes associated with age at menarche (AaM) in women in the variance of heifers' age at puberty (AaP). The ultimate aim would be to use the incredible amount of genomic knowledge now available in humans to improve accuracy of genomic breeding values for traits such as AaP.

Methods

We mapped 205 protein-coding genes associated with AaM in women (Day *et al.*, 2017) to the UMD3.1 bovine genome and located variants in or around ± 100 Kbp using imputed sequence data from three cohorts: Smart Futures, Tropical Composite and Brahman (Johnston *et al.*, 2009; Corbet *et al.*, 2018). We estimated the variance of AaP explained by orthologous AaM genes using a model with two genomic relationship matrices (GRMs) constructed from SNP genotypes; one for AaM genes and another for the remaining protein-coding genes. Using the same procedure, we estimated the AaP variance of 100 random gene-sets of similar size (gene length and number of SNPs).

Results

Variants within 100 Kb of AaM bovine orthologous genes explained 2.5% phenotypic (11.2% genetic) variance of heifers AaP in the Smart Futures cohort (Table. 1.). This represented about twice the mean variance explained by random gene-sets (1.2% phenotypic and 5.6% genetic). AaM bovine orthologous genes explained lower percentages than random gene-sets in the other two cohorts.

Table 1. Estimated genetic variance (%) explained by AaM genes and all variants (h²).

Gene set	N. Variants	Cohort					
		Smart Futures		Tropical Composite		Brahman	
		h ²	se	h ²	Se	h ²	Se
AaM genes	317,042	2.5	1.9	0.5	5.9	1.5	5.8
All variants (h ²)	28,960,002	22.0	3.1	39.8	8.5	46.1	9.2
Random gene-sets (mean) 100 random genesets (379, 325 snps)	379, 325	1.2	0.1	3.4	0.9	2.2	0.9

Discussion and Conclusion

The estimated h² is consistent with previous results for these cohorts (Johnston *et al.* 2009; Corbet *et al.* 2018). Some genes affecting AaM were also significant for AaP in heifers ($P < 1 \times 10^{-4}$). Our work highlights the potential of cross-species analyses to increase the industry's productivity.

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217 The FORAGE “Pasture Growth Alert” report: assessing risks to pasture growth and pasture resilience

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Introduction

Making decisions to adjust property livestock numbers at critical times can be difficult for land managers. This period may be at the end of the growing season, during the dry season, or when waiting for rain at the start of the wet season – with the intention to always maintain the best possible property land condition. The FORAGE Pasture Growth Alert report (PGA) can assist with making those decisions, by giving an ‘all round’ score based on recent and future pasture growth, as well as consideration for ground cover to preserve soil moisture and prevent runoff from storm rain.

The PGA report is the latest addition to the suite of FORAGE reports found on the Long Paddock website (<https://longpaddock.qld.gov.au/forage/>). The report provides an assessment of reduced pasture growth and pasture resilience risk for a property [lot(s)/plan]. It can be used to assist in stock and property management decisions to increase property resilience to drought and help to identify pasture recovery opportunities by assessing the property for the: last 12 months pasture growth; monthly ground cover percentile and pasture growth outlook for the next 6 months.

The Pasture Growth Alert report is a four page report which includes:

- background information section for **current and historical property context**
- a **pasture growth and resilience indicator** showing the risk level of reduced pasture production and property resilience for the next 6 months (Fig. 1).
- **modelled pasture growth graphs** for past 12 months and the next 6 months.
- a **monthly percentile ground cover map** showing how the property compares with the historical ground cover record for the same month.
- **12-month regional rainfall and modelled pasture growth percentile maps** (i.e. relative to history) to provide spatial context of the property to the local and surrounding shires.
- suggested **management considerations** to support each different **level of risk**.



Fig 1. Risk level of reduced pasture production and property resilience for the next 6 months.

The Pasture Growth Alert report can be accessed from Long Paddock website (<https://longpaddock.qld.gov.au/forage/>), for Queensland properties. Reports are requested by entering lot(s)/plan, entering property name/address or selecting directly from the interactive map.

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218 The role of FutureBeef in marketing and extension

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Introduction

The seven ‘touches’ rule is a common marketing theory used commercially worldwide. The theory indicates that it takes seven communications (of any form) with a consumer before they will commit to an idea or undertake the requested action. For online content contributors to FutureBeef.com.au where the intent of the content is to inspire action or behaviour change, the theory would suggest that a multi-pronged approach would be more successful at raising exposure and awareness of project outcomes than a singular post. Additionally, users of FutureBeef.com.au only spend on average two minutes and forty-eight seconds on a FutureBeef page before either viewing another page on FutureBeef.com.au, or exiting the website (Google analytics, 2019).

To combine the seven touches marketing theory and the behaviour analysis of users of FutureBeef.com.au, the following e-communication strategy is advised for FutureBeef content contributors

Method



Fig. 1. Provides a schematic representation of how the ideal e-extension strategy provides maximum exposure of information to FutureBeef followers. The project page acts as the trunk of the tree where all the detailed information about the project is located. The news articles, that become eBulletin articles, are the branches—smaller, less technical, attractive articles written in plain language with key messages in the early paragraphs that can be read in under three minutes. Social media posts are the fruit that attract a reader to the branch and then to the trunk of the tree.

Discussion

Utilising this format of electronic information dissemination through a number of online mediums, maximises project exposure over a minimum of three ‘touches’, almost halfway to the marketing success rule of seven that is required to inspire a purchase or behavioural change. Such a strategy compliments other contributions to the seven touches by encouraging event attendance at field days, workshops or webinars or contact with an extension or research officer.

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219 Proposal for consideration: Increasing adoption through campdrafting

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Introduction

A question often asked by organisations participating in research, development and extension for Australia's northern beef industry is: How can rates of adoption be increased? In this paper the authors highlight the importance of regionally based research and extension officers, and the opportunities that occur in those locations that allow staff to develop solid rapport with stakeholders—a key requirement to securing the adoption of research findings.

When extension officers are able to have credibility and interpersonal communication with their target group, they are able to transfer technology and secure adoption at a considerably higher level (Guerin & Guerin, 1994). Beef producers in northern Australia are typically time poor, often having to travel 500 km or more to attend extension activities. Similar distances and amounts of time are required to attend social and community events, however, priority for travelling away from the station is usually given to a community event. Gibson & Connell (2015) stated that participation in community events fulfils “an important civic emotional and psychological role in lifting community spirits and bringing communities together in otherwise adverse circumstances.”

Work within the community by research or extension officers can have a considerable impact on relationships formed with the target audience. Anderson (as cited in Guerin & Guerin, 1994) stated that “extension officers work with people, and therefore must be able to relate with them. They must be able to understand their problems and needs.” This statement is supported by Mwangi (1998) who found producers and extension officers “should operate in mutual interest networks by establishing rapport through friendship, and by avoiding any sense of superiority by either party.”

The answer proposed in this paper to the perpetual question of how to increase rates of adoption in the northern beef industry, is to emphasize the need for regionally based research and extension staff and their participation in community events (such as campdrafting), where rapport and trust with stakeholders can be established.

Discussion

While volunteering at campdrafts and/or competing alongside industry stakeholders, regionally based research and extension staff are able to demonstrate shared interests, skills and values, thereby developing not only rapport, but the underlying foundations of long term professional relationships from which trust is established.

Extrapolation and combination of the previously cited literature suggests that by supporting and encouraging regionally based research and extension staff to actively participate in community events, such as campdrafting, increased rates of adoption of research findings may be achieved.

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220 Extension activities to improve technology use on farm

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Introduction

The Grazing Best Management Practice program incorporates a voluntary, online self-assessment for beef producers and extension activities designed to assist in improving enterprise productivity and sustainability. The use of technology on farm is ever increasing, resulting in improved efficiency and reduced labour. Producers are utilising scales and cattle recording systems but are often not making best use of the technology capabilities. The Burnett Mary and Fitzroy DAF Beef Extension teams partnered with private product providers to deliver two workshops in Gayndah and Rockhampton highlighting how the herd information recorded could be beneficial. Presenters discussed what information was important to record, how to interpret the data and transform it into useful information for management decision making. Service and product providers discussed the available technology and practical tips for operation. This paper presents a summary of the success of these workshops and associated producer feedback.

Results and discussion

The communication of the best management practices regarding technology use was delivered to a total of 75 people. These producers covered a combined area of 154 000 ha and managed 41 000 head. The workshops were very well received with an average satisfactory rating of 85% (Table 1). The producer feedback indicated that cattle records were often not recorded, features of the current system were not being used and records were being kept without being used for management purposes. The average intended level of practice change as a result of attending the workshop was 82% with money or limited time being the most common reasons for not implementing change, not a lack of understanding or resources. The uptake of key messages can be attributed to producers feeling supported with contacts for assistance and leaving with the necessary skills required to improve their current practices. Showing the information recorded and providing the data manipulation templates used at Brian Pastures Research Station highlighted exactly what could be done and how. Collaborating with product providers was a useful technique to attract producers to the workshop and ensured the troubleshooting and practical guidance to get started was provided. The success of these workshops measured through participant approval and intention to practice change demonstrates the value of Grazing BMP funded extension activities and the multi-disciplinary team conducting delivery.

Table 1. Summary of producer feedback

	Level of achievement
Number of participants	75
Approval rating of workshop	85%
Intention to make practice change	82%

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222 E-Beef Smart Farming in Northern Queensland – improving pasture and business sustainability through adoption of the latest tools and technologies

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Managing cattle production in the rangelands of northern Queensland is a challenging job. E-Beef Smart Farming in Northern Queensland aims to support producers by showing how technology can support timely management decisions that enhance pastures, groundcover, soils, land condition, business profitability and adaptability.

The E-Beef Smart Farm Project, funded by the National Landcare Program, is a collaboration between three northern Queensland Natural Resource Management (NRM) regions – Southern Gulf, Northern Gulf and Desert Channels; in partnership with the Queensland Department of Agriculture and Fisheries and innovative commercial agribusinesses.

The project involves the establishment of six Smart Farm demonstration properties and associated Innovation Hubs (learning groups) to investigate the relationship between weekly averaged live cattle weights; regular satellite data measuring greenness and groundcover; and their impact on a business's profitability using a business analysis platform over three seasons.

It is demonstrating that groundcover, land condition, animal performance and marketing are intrinsically linked, and that business resilience is strengthened through integrated management of both natural resources and animal production.

Each Smart Farm is tracking a mob of commercial cattle using Tru-Test remote walk-over-weigh technology to record cattle liveweights; remote-sensed NDVI data supplied by the Queensland Department of Environment and Science; real-time cattle values; and AgriHive Farmecco software which provides an easy to understand visual business analysis. Three Smart Farms were established in May 2019 with another three established in August 2019.

Each member of the six Innovation Hubs, each associated with a Smart Farm, is tracking their own property's NDVI data and are comparing Smart Farm cattle liveweight changes to their own similar mob on similar land types, taking into consideration their own seasonal conditions. In total forty Innovation Hub participants are undertaking confidential business analysis of their businesses over four financial years using Farmecco.

A separate aspect of the project provides graziers with the opportunity to trial other smart tools and technologies that lead to better landscape and business sustainability. These graziers will ascertain the practical and cost benefits of the tools and technologies to rangeland grazing businesses and increase their adoption across the industry.

The project includes a comprehensive extension program to accelerate the uptake of whole-of-business grazing best management that when adopted will improve the natural resource base and profitability of beef enterprises. Extension professionals will partner with collaborators to maximise impact and ensure industry relevance.

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223 Watching the grasses grow: using UAVs and satellites to monitor rangeland species composition

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Rangeland monitoring methods traditionally involve intensive and time consuming fieldwork. New sensing technologies (e.g. drones, satellite imagery) have the ability to rapidly collect large data sets at relatively low cost. These data are operationally used for greenness and cover analysis but due to the complexity of grass phenological response, the classification of individual species remains a challenge.

This paper reports on new research using unmanned aerial vehicles (UAVs) with a multi-spectral camera to monitor the temporal reflectance changes of four grass species (*Bothriochloa pertusa*, *Bothriochloa ewartiana*, *Heteropogon contortus* and *Aristida sp.*) common in rangelands of north Queensland. Grass seed was collected from Wambiana Station, Charters Towers, QLD and stored for six months to break dormancy. Seed was sown in pots (290 x 290 x 400 mm) containing Brigalow or Box soil and irrigated daily until all grasses reached a minimum height of 150 mm. A calibrated Parrot Sequoia multispectral camera was used to capture daily images of germination and seedling growth. The pots were then allocated in a randomised block design with each grass species-soil type combination subjected to different simulated rainfall (high or low) and grazing pressures (high, low or no grazing) (n=4 replicates/combination). A DJI Phantom 4 Advanced UAV fitted with the multispectral camera was then used to capture daily high-resolution images of the grasses for 140 days.

An automated workflow was developed to extract the multispectral response of each experimental pot from the imagery to link the phenological response to the simulated grazing and rainfall combinations. Early results indicate substantial spectral variability within species. However, several species combinations may be identified under certain rainfall and grazing regimes. If this technique is found to be successful, it would be a new means to monitor changes in pasture species composition on these rangelands.

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224 FutureBeef: northern beef industry collaboration

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Introduction

The provision of timely, relevant and accurate information, and the delivery of industry engagement activities are essential for the northern beef industry. However, it is difficult and inefficient for primary industry government organisations and industry bodies to do this in isolation by creating and maintaining beef-related information on their own websites, plus managing promotion and engagement with industry members.

FutureBeef provides a coordinated and collaborative approach to the delivery of online information, promotion and industry engagement, and continues to give the northern beef industry access to a 24/7 one-stop-shop for beef information.

Partners

The FutureBeef partners are:

Queensland Department of Agriculture and Fisheries (DAF)

- Northern Territory Department of Primary Industry and Resources (DPIR)
- Western Australia Department of Primary Industries and Regional Development (DPIRD)
- Meat & Livestock Australia (MLA).

The current FutureBeef partnership began on 23 March 2018 and ends on 28 February 2022.

Objectives

The objectives of FutureBeef are to support sustainable and profitable productivity gains for northern beef producers by providing:

1. engagement, support, awareness and education of producers and beef industry service providers via the FutureBeef:
 - a. website: www.futurebeef.com.au
 - b. webinars: live webinars conducted on timely and relevant topics
 - c. social media channels: Facebook (www.facebook.com/futurebeef) and Twitter (www.twitter.com/futurebeef)
 - d. eBulletin: published through mailchimp
 - e. multimedia materials: webinar recordings and videos hosted on the FutureBeef website and YouTube channel (www.youtube.com/futurebeefau)
 - f. newspaper features (6-8 page lift outs published in the Queensland Country Life three times per year).
2. a platform to seek and enable opportunities for collaboration on common needs.

Other papers in this conference proceedings discuss some of these FutureBeef communication channels in more detail.

How you can get involved

Anyone working in the northern beef industry, even those outside the FutureBeef partnership, can use the FutureBeef network for industry engagement and promotion. Submissions can be made to info@futurebeef.com.au.

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225 Ceres Tag – Development of a smart ear tag for livestock

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Introduction

Knowing how many cattle are on a property, where they are and what they are doing are critical to improving productivity and profitability of beef enterprises. The industry has become familiar with the use of radio frequency ID (RFID) tags through the National Livestock Identification System (NLIS) which was launched in 2004. Over the ensuing 15 years information technology (IT) has advanced apace and the era of “smart” ear tags for the industry is upon us. The idea of an “active” tag that collects and relays information from the animal to a centralized interface is highly attractive to the industry as it could assist in the monitoring and management of livestock across the supply chain. Through the MLA Donor Company Ceres Tag and CSIRO are currently part way through a program to develop a smart ear tag for the industry that can be retained on the animal throughout its lifetime, is NLIS compliant and can provide near real time information on the whereabouts and activity of animals.

Methods

Following consultation with industry the design attributes of a “minimum viable product” were established. The two main components of development were the physical design of the housing and retention system of the tag and the electronics required to allow the tag to perform. The prototype version of the tag incorporated NLIS compatibility, radio communications, a global positioning system (GPS) capability, an alert when activity deviates from baseline, an alert when the tag breaks a paddock boundary and two-way communications.

Results to date



Figure 1. Design concept smart tag

Several iterations of the tag have been developed (Figure 1) and tested on cattle. A two-pin retention system is under development. The weight and size of the tag has been reduced to less than 40 g and less than 65 x 35 x 24 mm. Solar power provides the necessary energy to operate the electronics and recharge the on board battery. GPS position is recorded four times a day and on board algorithms detect abnormal activity that may be associated with worry from dogs, people or other unwanted sources, removal beyond the paddock boundary, ill health, oestrus or calving. A generalized alert is sent to the manager to check out the problem.



Figure 2. Prototype smart tag (attribution P. Valencia)

The tag is still under development but early results have confirmed that a commercially viable system can be achieved. Tests have been conducted on up to 100 head of cattle in north Queensland (Figure 2) and a test on a commercial property in the Northern Territory with 500 head is planned for the near future.

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226 Paddock Based Validation of Automatically Derived Dates of Birth

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Introduction

Time between consecutive calving dates (calving interval) can be used for genetic selection targeting female reproduction. In extensive cattle operations, it is difficult and costly to accurately record date of birth. Menzies et al. (2018) showed that remote technology could be used to estimate calving date. This paper presents results from a larger trial that refined the automatic detection of date of calving using the DataMuster Automated Livestock Management System (ALMS).

Methods

Data from 112 cows that calved in three paddocks at Belmont Research Station, Rockhampton, Qld, during the 2018/19 calving season were collected using ALMS. The data contained daily weights and average weekly weights. The weekly average weights were calculated using daily weight records, for each cow and removing any outliers. An algorithm was developed that used a combination of weekly average weights and daily weights to estimate dates of birth. The estimated calving dates were compared with visually recorded calving dates.

Results

The algorithm was able to accurately predict 73% of calvings (n=82) within one day of the observed calving date, 92% of calvings (n=103) within one week of the observed calving date and 96% of calvings (n=108) within two weeks of the observed calving date. Irregular use of the ALMS by cows in the days or weeks around the time of calving was the major cause of discrepancy between predicted and observed calving dates.

Discussion/Conclusions

The current algorithm shows great promise in accurately identifying calving. There are still challenges in ensuring cattle access the ALMS sufficiently regularly to be able to confidently determine an accurate calving date. Plans to address these challenges are underway. Further analyses is also being conducted to determine whether an accuracy value can be applied to the data that is used to estimate calving dates. This approach could be used to rank data that might be used to assign genetic selection indices.

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227 Understanding percentiles for climate and grazing land management decisions through story-telling animation

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Introduction

The use of historical climate records and seasonal outlooks are increasingly important for agriculture and natural resource management decision making. To improve the use of this information, land managers need to be able to understand and interpret percentiles, the statistical measure in which climate data and other measures are often calculated and communicated. Unfortunately, percentiles are frequently misunderstood and misinterpreted.

A combined animation and story-telling approach is an innovative way to address such misinterpretations. Animation is often used in the sciences to a diagrammatic effect; as it allows phenomena to be visualised, simplified and annotated. In this instance, an educational animation was employed with a story-telling effect, to positively contribute towards learning outputs and create social change.

A creative collaboration with scientists from the Queensland Department of Environment and Science (DES) and a professional artist through the “Artist in Residence Science program” (AIRS) have used these approaches to create an animation to disseminate scientific information through a character driven narrative. Specifically, to calculate and interpret rainfall percentiles for a grazing enterprise, entitled “*Understanding percentiles in climate data: This season might not be as great as you think it is, Jim*” (Fig. 1). The animation was piloted with a range of potential end users (extension providers, consultants, land managers), with unanimous positive feedback.

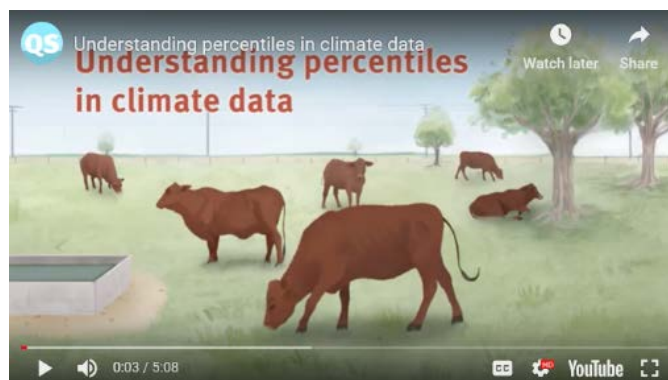


Fig 1. Screen capture from the *Understanding percentiles in climate data* video.

The animation concentrates on Queensland rainfall percentiles. The statistical information presented in the animation is relevant to anyone who interprets percentiles for a range of purposes (ground cover measurement, pasture growth). Additionally, it is anticipated that it will contribute to existing literature, educational and communication products to improve land managers’ scientific literacy. The Percentile Animation video can be accessed from the Long Paddock website (<https://longpaddock.qld.gov.au>), on the AussieGRASS, FORAGE and Rainfall poster web pages.

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228 Calf Watch – Developing a system to remotely monitor calving and study calf loss in extensive situations in Northern Australia

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Introduction

It has been difficult to investigate calf loss in northern Australia using traditional methods as calving females are difficult to find in large paddocks and close observation during calving alters behaviour and can even cause mismothering. Also calf carcasses are difficult to find under extensive conditions and so it is often not possible to conduct autopsies to determine the cause of calf deaths. If calving could be monitored remotely it would enable collection of data that was not previously possible. This would greatly increase knowledge about calf loss and help identify solutions to reduce it.

Researchers at the University of Florida (UF) modified an existing “barn” system of birthing sensors (<http://cowmonitor.com/technology/>) to increase the footprint area and remotely monitor calving, and a new project (Calf Watch) aims to adapt this system for use in northern Australia and then to use it to investigate the causes of calf loss. The UF system uses birthing sensors that are inserted into the vagina of pregnant cows up to 4 months before calving. When sensors are expelled at birth, the rapid change in temperature causes them to start emitting a UHF signal that is received by antennas mounted on towers in a low-power wireless-area network (LPWAN). Signals are transferred by a gateway, via the internet to servers owned by the sensor manufacturer (JMB). A calving alert is then sent and is also immediately viewable on a website. Researchers must then find the sensor and calving site using Bluetooth beacon and LED light, collect any dead calves for autopsy or observe and tag live calves (if possible) with a VHF emitting trackable ear tag that contains an accelerometer. Tagged calves are monitored remotely and if the accelerometer does not move for 2 hours, signalling a possible mortality event, the VHF tracking tag can be located with a portable yagi.

Materials and methods

The equipment was set up at a research site near Katherine, NT and found to work successfully. Each tower had a read range radius of about 1.7 km in 360 degrees from the tower and 4 towers gave satisfactory coverage of the 2,215 ha trial paddock. A pilot study was conducted with one tower to test the system in a smaller paddock (87 ha) at Katherine Research Station. Birthing sensors were inserted into 18 pregnant cows with foetal ages ranging from 5 to 9 months on 9/11/2018. The equipment was monitored and cows checked daily to see whether alerts would be received when calves were born.

Results and discussion

Some problems with equipment were encountered during the pilot study (eg. one type of antenna caused gateways to fail) but they were resolved. Email alerts were successfully received for all births while the system was working properly, however only 9 of the 18 expelled sensors were able to be located. This reinforced the need for additional spatial reference such as GPS coordinates especially for larger paddocks. JMB has suggested that one viable option is to put GPS chips in sensors and if successful we plan to use them in late 2019 to study the cause of calf loss in 200 cows in the 2,215 ha trial paddock. A second option is to locate cows with additional tracking tags (GPS or VHF) once sensor alerts have been received. This system looks promising as a method to remotely monitor calving, although a more precise method of locating the birth site is required for north Australian conditions where paddocks are larger and have more trees and longer grass than the research sites in Florida.

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229 Intensive rotational grazing of improved pasture in the NT - update

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Introduction

Schatz (2016) reported results from the first 6 years of a 9 year study at Douglas Daly Research Farm (DDRF), NT, in which the liveweight gain (LWG) of steers was compared under continuous grazing (CG) and intensive rotational grazing (IRG) regimes. After 6 years the number of paddocks in the IRG treatment was increased to increase the number of rest days between grazes. This paper reports on the final 3 years of the study after this change was implemented.

Materials and methods

In each year of this study, beginning in , Brahman and Brahman cross weaners (average weight ~ 175 kg) were randomly allocated, after stratifying for weight, to one of the following treatments: IRG, CG_c (CG where the stocking rate remained constant at 1.5 head/ha), or CG_v (CG where the stocking rate varied so that it was always the same as the effective stocking rate over the total area of IRG). They grazed predominantly (*Cciliaris*) pasture from shortly after weaning for about a year at which time they were replaced by the next year group. The stocking rate (over the total area) in IRG varied each year according to assessment of pasture availability and ranged from 1.33 to 1.83 head/ha (the number of animals in the IRG group ranged from 210 -288). The amount of time the IRG group stayed in a paddock depended on the time of year and stage of pasture growth, and ranged from 1 – 3 days. For the first 6 years IRG rotated around 26 x 6 ha paddocks while the 2 CG treatments grazed 3 x 6 ha replicate paddocks per treatment. From the CG_c treatment was discontinued and the 3 x 6 ha paddocks plus another 33 ha paddock were added to IRG. This had the effect of increasing the number of paddocks in IRG to 30 and the number of rest days between grazes to around 70 days in the early wet season, 35 days in the mid to late wet season and 105 days in the dry season.

Results and discussion

In each of the first 6 years of the study LWG was lowest per head and per ha in IRG ($P<0.05$), and LWG per head was highest in the CG treatment with the lowest stocking rate, while LWG per ha was highest in the CG treatment with the highest stocking rate. In the final 3 years of the study LWG continued to be lowest both per head and per ha in IRG ($P<0.05$), and the differences between treatments were actually greater in the final 3 years than they had been in the previous 6 years (Fig. 1). The average difference in total year LWG per head between the IRG and CG_v treatments in the first 6 years was 22.1 kg and in the last 3 years it was 44.0 kg. In summary, in each year of this 9year study the growth of cattle grazing improved buffel pasture was worse under IRG than CG.

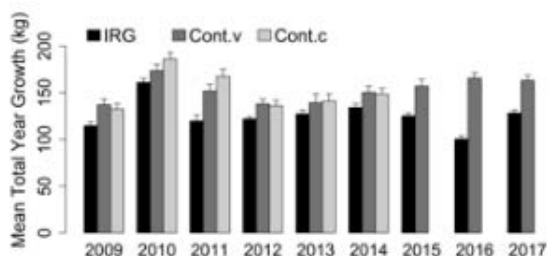


Fig. 1. Annual LWG per head of treatments in the DDRF intensive rotational grazing trial.

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230 Benchmarking to improve long-term carrying capacity estimates for extensive grazing properties in Queensland

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Introduction

Safe carrying capacity information can assist producers in making stocking rate decisions to ensure minimal decline in land condition over the long-term. FORAGE, a modelling framework which uses the GRASP pasture growth model, spatial data, remote sensing and climate data, provides long-term carrying capacities for individual paddocks and land types for grazing properties in Queensland. Applying the framework across Queensland's diverse grazing lands and capturing the large range of land types and climates is challenging. To overcome this challenge, we will collate on-ground data and expert-knowledge for reference properties to help validate the modelling framework and ensure the best-available safe carrying capacity information is provided.

Methods

'Benchmarking' of practical information from experienced graziers who have been managing their livestock to ensure land condition is maintained or improved provides a reference to which modelled carrying capacity estimates can be compared. Properties that are well-managed and in good condition with a good density of perennial plants are being targeted. Property boundaries, land types, infrastructure, foliage projected cover and ground cover are mapped prior to the property visit. Land condition is assessed at a number of sites across the property. Through consultation with experienced graziers and use of long-term stock records and land condition assessments, a verified long-term safe carrying capacity estimate can be produced for each property.

Application

Newly established benchmark properties, historic grazing trials and carrying capacity projects will be collated in a verified GIS-based library of safe carrying capacities. This information will be used as a reference for current models, future developments to the models, and to increase knowledge of stocking rate strategies which achieve sustainable production. Knowledge of long-term carrying capacities and number of animals carried over a defined period, as learned from experienced graziers, enables us to review and refine sustainable levels of utilisation for land types.

Improved property-based carrying capacity information will assist grazing land management decisions that promote both sustainable natural resource use and profitable beef and sheep industries.

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23 | The re-emergence of dieback in pastures across Queensland

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Introduction

Pasture dieback is a condition currently causing death of a range of sown and native pastures across large areas of Queensland's productive grazing lands. Pastures affected by this condition are rendered unproductive, leading to significant financial distress for affected graziers.

Symptoms of dieback in Queensland pastures

Initially, leaves of affected plants turn yellow and/or red starting at the leaf tips then progressing towards the stem. Plant growth is halted. Eventually death occurs typically in patches across the landscape. In some cases affected pastures regenerate naturally from the soil seed-bank. In other situations patches are colonised by broadleaf plants for some years after the episode.

History and current area affected by pasture dieback in Queensland

The earliest report of "dieback" in Queensland was in *Paspalum* pastures near Cooroy (Summerville 1928). A mealybug was the suggested cause of this occurrence. The next report was around 1993-4 when dieback was recorded across central Queensland primarily in buffel grass pastures. Despite previous research (Graham and Conway 2000; Makiela 2008), no definitive causal agent(s) have been confirmed. Dieback in pastures has again re-emerged and recent outbreaks were first identified in 2012 in buffel grass pastures in central Queensland and in creeping blue grass pastures in central and coastal Burnett districts (Buck 2017). Most sown grass species are susceptible to dieback across Queensland. Observations have occurred from the Atherton tablelands in north Queensland, through eastern Queensland to the south-east corner of the state.

Accurate identification of pasture dieback is problematic due to overlap of similar symptoms from dry weather and pasture rundown. Not all graziers are aware that they have dieback on their property and those who do, find it difficult to accurately measure the impact. Based on direct contact with over 120 graziers the area affected was estimated at around 35,000 ha in mid-2017 (Buck 2017). A recent survey of 88 graziers has estimated the affected area at almost 60,000 ha (AgForce 2019). Anecdotal observations suggest that the area affected by dieback is increasing and considered to be much larger than reported. Continuing research is needed to identify the causal agent(s) and effective management options for graziers to restore productivity.

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232 The Drought Map Sequence viewer: arranging rainfall and pasture maps for explaining drought situations

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Introduction

Viewing current drought status or retrospective maps (for Queensland) has been possible for some time by visiting the “Drought Declaration” page on the Long Paddock website <https://www.longpaddock.qld.gov.au/drought/drought-declarations/>. However, there is often an interest in the contributing factors that are associated with the evolution of a drought situation (i.e. rainfall, pasture growth). Therefore, additional information about current and past factors that impact on regional areas can be helpful in understanding drought conditions.

The new *Drought Map Sequence viewer* (DMSV; Fig 1.) provides arrangements of drought maps along with the suite of AussieGRASS maps for analysing and better understanding current and past contributing factors to the current seasonal conditions (e.g. for drought declaration and revocation). There is one standard screen (Fig. 1) which relates the most recent drought situation map, along with rainfall and pasture growth percentile maps (for the previous 12, 24 and 36 months). Alternatively, the DMSV can be userdefined to select another time period, plus other variables (e.g. soil moisture, runoff), with different time sequences (i.e. monthly, annually). If required, the map selection can then be saved as a PDF document for printing, emailing or presenting.

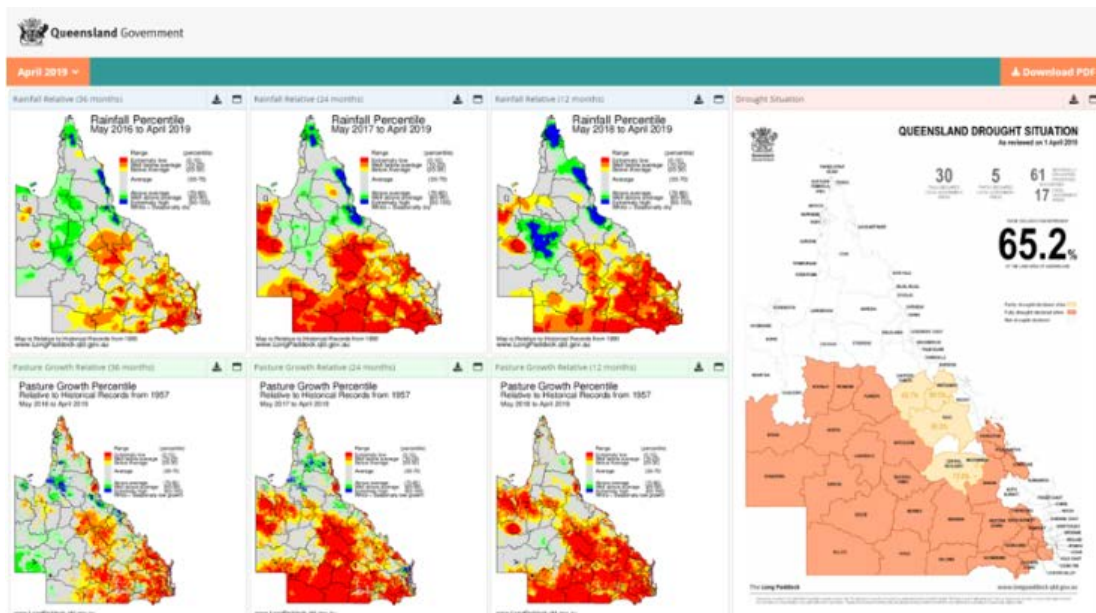


Fig 1. The Drought Map Sequence viewer – standard screen view.

The DMSV can be used for other Australian states and territories, however, the drought situation map will not appear for non-Queensland views/selections. The viewer can be accessed from the Drought Declaration page on the Long Paddock website

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233 Effective phosphorus supplementation improves profitability

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Introduction

Phosphorus (P) deficiency in many pasture regions across northern Australia severely reduces productivity of grazing cattle. However there has generally been low adoption of effective P supplementation. One important reason appears to be a lack of understanding of the profitability of P supplementation of P deficient cattle (Dixon et al. 2011). This study evaluated the profitability in 2 dissimilar regions of northern Australia: (1) the Katherine region of the NT, and (2) the Fitzroy Natural Resource Management (NRM) region of central Qld.

Methods

Property-level, regionally-relevant herd models were used to determine whole-of-business productivity and profitability over 30 years. The economic consequences of P supplementation at the property level were assessed by comparison of baseline production (no P supplementation) to the estimated production of P-supplemented herds, and included the implementation phase and the changes over time in herd structure. In the Katherine region it was assumed that the entire herd (breeders and growing cattle) grazed acutely-P-deficient land types and the consequences of (a) no P supplementation, or P supplementation during (b) the dry season, or (c) both the wet and dry seasons (i.e. 3 scenarios) were evaluated. In the Fitzroy NRM region it was assumed that only the breeders grazed P-deficient land types with 3 categories of P deficiency (marginal, deficient and acutely deficient), each with either (a) no P supplementation, or P supplementation during (b) the wet season, (c) the dry season, or (d) both the wet and dry seasons (i.e. 12 scenarios).

Results

In the Katherine region year-round P supplementation of the entire cattle herd grazing acute P-deficient pasture resulted in a large increase in business profit (\$500k/annum). Supplementing with P (and N) only in the dry season increased business profit by \$200k/annum. In the Fitzroy NRM region P supplementation during any season, of the breeder herd grazing deficient or acutely deficient pastures, increased profit by \$2k-\$45k/annum. Importantly, P supplementation during the wet season-only resulted in the greatest benefits: \$6k, \$6k and \$45k additional business profit/annum for marginal, deficient and acutely P-deficient herds, respectively.

Discussion and Conclusion

The large economic benefits of P supplementation for northern beef enterprises estimated in the present study substantiate the current industry recommendations that effective P supplementation is highly profitable when cattle are grazing P-deficient land types. The contradiction of large economic benefits of P supplementation and the generally low adoption rates by the cattle industry in northern Australia suggests a need for targeted research and extension to increase adoption.

References

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234 Risk factors of cows associated with plasma inorganic P concentration of calves at weaning.

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Introduction

Assessing the inorganic phosphorus concentration in plasma (PiP) is the currently recommended diagnostic test to determine the phosphorus (P) intake of growing cattle. However, PiP is less suitable for use in cows during late pregnancy and lactation when body tissue and skeletal reserves are often mobilised to meet the high P demand for foetal growth and milk production. Consequently, PiP is also less suitable for calves due to a poor correlation between P content of milk supply and the P content of the dam's diet. The aim of this study was to assess the strength of association between biophysical cow factors on the PiP of calves at weaning.

Materials and methods

Bos indicus heifers (n=179) were weaned at approximately 5 months of age and allocated to 2 groups that grazed P deficient pastures (soil Colwell P of < 3.2 ppm) at Victoria River Research Station, NT. The heifers were managed identically until four years of age, with the exception that one group received supplement that contained P (P+) and the other had access to the same supplement without P (P-). At the time of weaning their second calf-crop, cow-calf pairs were visually identified and calf age was estimated from foetal aging conducted in mid-pregnancy. Body condition score (BCS - 1 to 5 scale), fat depth and liveweight of cows and calves was recorded. Blood samples were collected from the jugular vein of all cows and calves into lithium heparin vacutainers for PiP analysis. The strength of association between PiP and each variable was assessed one at a time using a linear regression model in Stata, version 13.1. Variables with a significant association with PiP using a liberal p value (0.25) and not highly correlated (>0.9) with other variables were included in a multivariable regression model. A backward step elimination process was used to determine a candidate final model which contained only significant variables. All previously eliminated variables and two-way interactions were then considered for inclusion in the final model. Routine techniques were used to test that the assumptions of linear regression were satisfied.

Results and discussion

The dataset contained information on PiP and candidate cow risk factors for 69 calves. Overall, the mean PiP of calves was 2.4 mmol/L (range 1.4 to 3.2) at weaning (av. 5.5 months of age) and was 2.5 and 2.3 mmol/L for P+ and P- cows respectively. Univariate analyses indicated positive associations between calf PiP and dam treatment (P+ or P-), and PiP, BCS, liveweight and fat depth of dam. A negative association existed between calf PiP and calf age but there was no association between calf PiP and sex of calf and parity of cow.

In the multivariate analyses, significant associations between dam treatment (P=0.02) and age of calf (P<0.01) were identified and together described 17% of the variation in calf PiP. Calves from P- cows had PiP values on average 0.19 mmol/L lower than calves from P+ cows. This finding is thought to reflect the difference in the quantity of milk available to calves, which is likely a function of differences in BCS between P+ and P- cows. A 0.13 mmol/L decrease in PiP was estimated for each 1 month increase in calf age and is thought to be partially explained by milk yield and P content being lower in later stages of lactation and a transition from a milk to a P deficient pasture/supplement diet.

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235 The post-weaning performance of calves from cows with and without access to P during pregnancy and lactation

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Introduction

The availability of phosphorus (P) is often an important restriction to beef production in northern Australia. Depressed growth and milk production, after-effects of reduced intake, result when an animal's P demand is not satisfied by the diet or mobilising body reserves. Providing supplemental P to heifers and cows when grazing known low P areas is currently recommended during late-pregnancy and lactation, with substantial production gains demonstrated. Calf performance has been monitored with elevated weaning weight and pre-weaning growth evident when the P demand of cows satisfied.

The aim of this study was to investigate the effect of providing P supplements to cows during pregnancy and lactation on post-weaning performance of progeny when fed high and low P content diets.

Materials and methods

Two groups of mixed-sex weaners from 4 year-old cows (first mated at 2 years old) that had grazed native pastured paddocks of Victoria River Research Station known to be low in P were relocated to the Katherine Research Station pen trial area approximately 2 months after weaning, at approximately 8-10 months of age. Cow groups had been managed as similarly as possible since weaning, apart from one group having access to supplemental P (CowP+) and the other half having no access to supplemental P (CowP-). Within cow diet and sex groupings, weaners were randomly allocated to either a low P (WnrP-, 0.5 g P/kg DM) or high P (WnrP+, 2.8 g P/kg DM) diet group. Each treatment x Cow diet x sex was replicated 3 times, with each replicate equal to a pen of 2-4 animals.

Animals were introduced to the experimental diet over 9 days prior to entering the pens. Experimental diets were fed ad libitum for 50 days following a 2 week induction period.

Liveweight, intake and hip height measurements were recorded. Liveweight was recorded after a 15 h curfew at the start and end of the pen experiment, with interim uncurfewed weights recorded weekly. Feed intakes of each pen were calculated weekly and hip height recorded at the start and end of the feeding phase.

Results and discussion

On entry into the pens, differences between cow diet existed for weight. On average, heifers and steers from P+ cows were 6.4 kg (174.5 vs. 168.1) and 23.9 kg (183.2 vs. 159.3) heavier, respectively, when compared to similar weaners from P- cows. These differences are thought to reflect differences in quantity of milk delivery and cow body condition score at calving.

Weaner diet was strongly associated with growth ($P < 0.001$) with the average growth of weaners on the P+ diet was 40.9kg greater than the P- weaner diet. The 1kg less dry matter intake per 100kg liveweight present in P- weaners is thought to largely explain this response. Both of these responses were independent of cow diet and thus, differences in weaning weight, measured at the start of the trial, were still present at the end of the trial.

These results suggest that the P content of cow diet during pregnancy and lactation had little or no effect on post-weaning performance, despite weaners being fed diets differing in P content. Diets low in P were shown to significantly affect the post-weaning performance of young cattle.

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236 Effect of Phosphorus supplementation on female reproductive performance in phosphorus deficient country in the NT

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Introduction

The effect of phosphorus (P) supplementation on the growth and fertility of Brahman heifers at Victoria River Research Station (VRRS) up to weaning of the first calf crop was reported by Schatz and McCosker (2018). This paper summarises performance up to the third calf crop.

Materials and methods

In June 2014, 179 Brahman weaner heifers were randomly allocated to either a +P (n=91) or -P (n=88) treatment (stratified for weight). The treatments grazed separately in acutely P deficient paddocks (average Colwell P: 2.5 and 3.1 mg P/kg) and they swapped paddocks in May each year. The treatment groups were managed in the same way except for their supplement which either contained P (P+) or did not (P-). Heifers were mated for the first time as two year olds for about four months from early January 2016 and then each year from early January for about 4.5 months. Weight (curfewed), body condition score (BCS), hip height, P8 fat depth, lactation status and pregnancy test results were recorded twice a year (usually in May and September/October). Calves were weaned, weighed and mothered up by observation at the May musters.

Results and discussion

Schatz and McCosker (2018) reported that +P heifers had significantly heavier weights than -P heifers after the first post weaning wet season, the total weight of calves weaned from first lactation heifers was 3,072 kg higher in +P and the pregnancy percentage was 25 units higher in +P first lactation heifers.

The following year (2018) the average weight of calves weaned from P+ was 13 kg heavier than -P (+P=185 kg, -P=172 kg, P=0.09) and the total weight of calves weaned from the treatments was 2,804 kg more from +P. The pregnancy rate (%) in lactating cows was 40 units higher in +P (+P=60.0%, -P=20.0%, P=0.001) and the average weight of cows was 69 kg heavier (+P=426 kg, -P=357 kg, P<0.001).

In 2019 the average weight of calves weaned from P+ was 43.6 kg heavier than -P (+P=201 kg, -P= 157 kg, P<0.001) with 5,932 kg more total weight of weaners produced from +P than -P. The pregnancy percentage in lactating cows was 62 units higher (+P=69.5%, -P=7.5%, P<0.001), the average weight of lactating cows was 115 kg heavier in +P (+P=432 kg, -P=317 kg, P<0.001) and non-lactating cows were on average 128 kg heavier in +P (+P=543, -P=415 kg, P<0.001).

The total value of weaners produced from the first three calf crops was \$36,373 more from +P than -P and the extra cost of supplement consumed by +P was \$7,089 compared to -P supplement in the dry season only. Comparing the extra value of weaners produced to the extra cost of supplement gives a cumulative return on investment of 513% for the +P treatment from the start of the study to May 2019. This value is indicative only. This calculation does not include the benefit of the 13% lower cumulative mortality rate (from the start of the study to May 2019) in +P treatment. The mortality rate in -P may have been even higher if the trial had not been stopped in May 2019 and supplementary feeding commenced for an additional 33% of P- cows that were in poor condition.

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237 Phosphorus supplementation and female PiP levels in the VRD, NT

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Introduction

Plasma inorganic Phosphorus (PiP) testing is the accepted method of determining the Phosphorus (P) intake and status of young cattle (Anderson *et al.* 2017). However little information is available on changes in PiP concentrations of heifers and cows grazing under extensive conditions in northern Australia. These were studied in a P supplementation trial at Victoria River Research Station (VRRS).

Materials and methods

In June 2014, Brahman weaner heifers were allocated by stratified randomisation based on weight to either a +P (n=91) or -P (n=88) treatment. The treatments grazed separately in acutely P deficient paddocks (average Colwell P: 2.5 and 3.1 mg P/kg) and swapped paddocks in May each year. The treatments were managed in the same way except that their loose mix supplement either contained P (P+) or did not (P-). Heifers were mated for the first time (as 2 year olds) between 5/1/16 and 6/4/16, calved in late 2016/early 2017 and calves were weighed and weaned on 23/5/17. Heifers were weighed twice a year (usually in May and September) and blood samples were collected in May for PiP testing.

Results and discussion

Heifer growth and PiP concentrations at different ages are shown in Fig. 1. The average weight of P+ heifers was significantly heavier ($P < 0.05$) than P- at each measurement after the first post weaning wet season (Schatz and McCosker 2018) and the average PiP was significantly higher ($P < 0.001$) for P+ than P- on each measurement date. The average weight of calves weaned from P+ was 33.7 kg heavier than P- ($P+ = 172.3$ kg, $P- = 138.6$ kg, $P < 0.01$) and while the average PiP of P+ calves was higher than P- at weaning ($P+ = 2.73$ mmol/L, $P- = 2.18$ mmol/L, $P < 0.001$) the PiP of P- calves was still quite high. This led to the hypothesis that P- first lactation heifers maintained milk P concentration but that milk production was higher in P+ heifers. Average PiP fell from 1.27 mmol/L to 0.71 mmol/L during lactation in P- first lactation heifers, whereas it actually increased from 1.52 to 1.81 mmol/L in P+ heifers. These results are explained by mobilisation of body P reserves in P deficient reproducing cows, although PiP is a less reliable indicator of P status during pregnancy and lactation (Anderson *et al.* 2017).

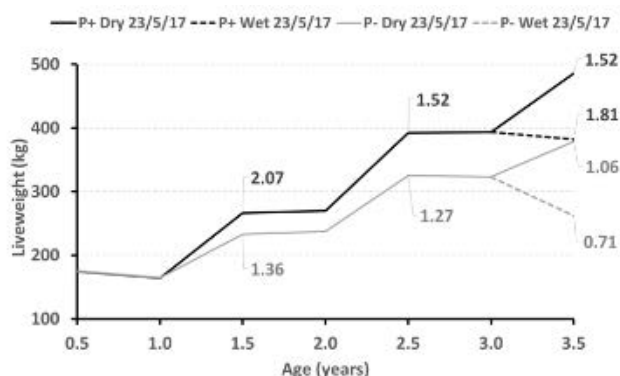


Fig. 1. Change in liveweight and PiP levels in P+ and P- supplemented heifers at VRRS.

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238 Brahman and F1 Senepol x Brahman heifer performance in the NT

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Introduction

Crossbreeding Brahmans with a tropically adapted *Bos taurus* breed such as Senepol is a way of producing animals that have more tender meat than Brahmans and higher growth due to hybrid vigour (Schatz *et al.* 2014). Animals with more tender meat give more marketing options although another consideration when planning a crossbreeding program is the performance of the females produced. This paper reports the pregnancy rates from the first two mating opportunities of four year groups of Brahman (BRAH) and F1 Brahman x Senepol (F1 SEN) heifers.

Materials and methods

Four cohorts (year groups) of BRAH and F1 SEN progeny were produced by mating Senepol and Brahman bulls to Brahman cows in the Katherine and Victoria River districts. Each cohort of heifers was managed together from weaning. Although the different cohorts grazed at different locations, management was similar across cohorts; They grazed native pasture, had access to mineral supplement year round and were mated first at approximately two years old for a period of about 4.5 months from early January. Senepol bulls were mated to the 2011 cohort while Brahman bulls were used for all other cohorts. Heifers not pregnant after the maiden mating were culled.

Results and discussion

F1 SEN heifers had significantly heavier average pre-mating weights (PM LW) at their maiden mating in each year ($P < 0.05$) (Table 1) and overall years (BRAH = 266.5 kg, F1 SEN = 303.1 kg, $P < 0.001$) and subsequently had higher maiden pregnancy rates (overall BRAH = 71.1%, F1 SEN = 89.5%, $P < 0.001$). Foetal and calf loss was lower in F1 SEN in three out of four cohorts and the difference between breeds overall years was significant (BRAH = 13.7%, F1 SEN = 7.6%, $P < 0.05$). The average weight of calves weaned per pregnant heifer retained was higher in F1 SEN in each cohort (except 2011 when Senepol bulls had been used) however the differences between breeds were not significant in each cohort or overall (BRAH = 128.4 kg, F1 SEN = 143.9 kg, NS). The pregnancy rate in F1 SEN first lactation heifers was significantly higher in the 2010 cohort ($P < 0.05$) but the differences in other cohorts and overall were not significant (BRAH = 10.3%, F1 SEN = 13.9%, NS). These results indicate that F1 SEN heifers performed at least as well as BRAH heifers in this environment, if not better.

Table 1. Performance of four year groups of BRAH and F1 SEN heifers in Katherine/VRD region, NT.

Cohort (year weaned)	2010		2011		2012		2013	
	BRAH	F1 SEN	BRAH	F1 SEN	BRAH	F1 SEN	BRAH	F1 SEN
PM LW (kg)	300.0 ^a	330.4 ^b	267.3 ^a	309.7 ^b	248.3 ^a	290.4 ^b	250.5 ^a	281.9 ^b
Maiden PR (%)	84.1 ^a	97.4 ^b	75.7 ^a	87.0 ^b	58.9 ^a	84.1 ^b	60.6 ^a	87.4 ^b
Calf loss (%)	17.6	3.4	14.7	14.8	12.2	4.3	11.9	6.3
kg weaned/heif. retained	139.9	167.0	131.2	128.8	121.5	130.4	120.9	149.5
1st Lactation PR (%)	20.4 ^a	42.9 ^b	8.0	5.8	1.5	6.1	19.2	18.9

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239 Probability of visualising a corpus luteum with ultrasound in cycling heifers

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Introduction

Ovarian ultrasound for a *corpus haemorrhagica* (CH), *corpus luteum* (CL) or *corpus albicans* (CA) defines cyclicity in non-pregnant cows or heifers. However, a CH is not usually visible, and nor is a CA once its diameter is less than 10 mm. The period of the oestrus cycles when no CH, CL or CA is visible has not been reported for tropically-adapted cattle.

Methods

Cycling tropically-adapted (n=23) heifers with averages (\pm sd) for live-weight of 306 ± 28 kg, for hip height of 135 ± 3.7 cm, for P8 fat thickness of 3.0 ± 0.1 mm, and for body condition score (1-5 scale) of 2.8 ± 0.04 were used. All visible structures in each ovary were described daily during ultrasound (Honda 2100V with a 10 MHz linear array rectal probe) scanning for 29 days.

Results

Average oestrus cycle length was 20.3 ± 2.2 days. Subordinate follicles reached a diameter of 6-8 mm before regressing. A CH was not visible as no luteal structure was seen for 3-4 days after ovulation of a 12-14 mm follicle. Post-ovulation echogenic areas were visible in several heifers, but they could not be discriminated from the previous cycle's CA. The luteal phase was defined in 18 heifers and on average represented 81% of the cycle (Table 1). A 1-5 mm cavity appeared in the CL when at or close to maximum size. Across all heifers, a CL or CA was visible for $84 \pm 0.11\%$ of the time, but a lower proportion when only heifers with a defined luteal phase were considered (Table 1).

Table 1. Average \pm sd for ovarian function measures in 18 tropically-adapted heifers

Follicular phase (days)	Luteal phase (days)	Max CL diameter (mm)	CH/CL/CA visible
3.7 ± 3.1	16.6 ± 2.5	14.6 ± 1.3	$81\% \pm 10\%$

Discussion and Conclusion

A similar result of 85% for probability of visualising a functional or regressing luteal structure between days 2 and 20 of the cycle with ultrasound is reported for dairy cows (McDougall & Rhodes 1999). This research will assist in the interpretation of infrequent ovarian scans, eg, 1-2 scans per year as part of large-scale studies. The percentage with a visible CL using the standard of ultrasound used in our research, or equivalent, could be divided by 0.84 to derive a more accurate estimate of percentage female cattle cycling.

Reference

McDougall S, Rhodes FM (1999). *NZVJ* **47**:47-52.

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240 Addressing vibriosis (bovine genital campylobacteriosis) diagnostics

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Introduction

Bovine genital campylobacteriosis (BGC) or bovine vibriosis is caused by the bacterium *Campylobacter fetus* subspecies *venerealis* and causes embryonic loss or early term abortion. Existing diagnostic methods are not able to accurately determine the presence of pathogens in clinical samples and economic disease impacts cannot be determined reliably. The main issue for diagnostic laboratories is the reliable transport of clinical samples to the laboratory and the ability to differentiate *C. fetus* subspecies and related bacteria. *Campylobacter fetus* subsp. *fetus* causes sporadic bovine abortions, usually of faecal origin. *Campylobacter fetus* subsp. *venerealis* is associated with herd outbreaks significantly affecting productivity, resides in reproductive tracts and is asymptomatic in bull carriers. Previous research identified a novel diagnostic target shown to be specific for subspecies *venerealis* to exploit for the development of novel diagnostic tests.

Methods

Two assays were developed to specifically detect and differentiate the 2 *C. fetus* subspecies: an allele specific polymerase chain reaction (PCR) and a TaqMan Single Polymorphic Nucleotide (SNP) quantitative (q) PCR (proprietary). These assays were compared to a commercial kit (VetMax™ *C. fetus* kit, Thermofisher) which reportedly detects *Campylobacter fetus* directly in clinical samples.

A panel of bacterial isolates (*Campylobacter*-related species including *Campylobacter fetus* isolates) collected from a local bull prepuce survey, diagnostic submissions and lab reference strains were used to optimise assays for specificity and sensitivity. To determine the ability to detect bacteria directly in clinical samples, quantified live bacterial cells were used to spike vaginal mucus and preputial smegma at varying concentrations.

Results

Using pure DNA preparations, the allele specific PCR and the TaqMan SNP qPCRs reliably differentiated and detected both *C. fetus* subspecies and were negative for closely related species such as: *C. hyointestinalis*, *Arcobacter cryaerophilus*, and *C. ureolyticus*. The ability to detect *C. fetus* subsp. *venerealis* directly in 'artificial' clinical samples was possible. The sensitivity of these new assays was limited compared to the VetMax™ *C. fetus* assay, which does not differentiate the 2 subspecies.

Discussion/Conclusions

This research demonstrates the development of specific PCR assays for the detection of *C. fetus* subsp. *venerealis* and the differentiation from the closely related subspecies *fetus*. Direct specific detection of *C. fetus* subsp. *venerealis* in clinical samples is feasible. However, while the new assays have a greatly enhanced specificity, the sensitivity of the assays is lower than that of the commercial assay. The commercial VetMax™ *C. fetus* assay, or equivalent tests, could be applied to directly pre-screen clinical samples. If positive, subsequent enrichment and specific detection using these new allele/SNP detection assays will confirm the presence of BGC.

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300 It is more cost effective to use irrigated pastures for hay than for grazing to grow beef in central Australia

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Introduction

Traditional grazing systems in central Australia's arid environment are based on extensive rangelands stocked at approximately 1 to 2 adult equivalents per square kilometre. Cattle under these conditions can gain 0.5-0.6 kg live weight per day post-weaning. Following the development of water allocation plans in the southern Northern Territory (NT) and changes to the *Pastoral Lands Act* to facilitate alternative land use on pastoral leases, there is interest in using irrigated pastures to increase production. Chisholm and Driver (unpublished) have previously recorded growth rates on Ooloo farm in the Ti Tree basin, NT, of steer grazing an irrigated and fertilised tropical Rhodes grass (*Chloris gayana*) pasture as high as 1.9 kg/day (averaged 1.36 kg/day over 110 days). However, Rhodes grass becomes dormant in winter but temperate crops such as barley, oats and rye can be grown during winter months, providing feed for stock or alternatively for use as a cash crop.

The objectives of the trial were to: 1) determine the economic viability of hay production vs. grazing steers on an irrigated temperate pasture mix, and 2) evaluate the production benefits of finishing steers for premium beef markets on an irrigated mixed pasture.

Methods

On Ooloo farm, in the Ti Tree basin, NT, a 56 ha pivot was sown to a temperate ('winter') mixed pasture comprising corn rye, Italian rye, oats, chicory and clover. Half the pivot area was cut for hay and the other half was divided into a further 5 cells using electric tape to be grazed under a 7-day rotation grazing system that allowed for a 28 day rest period. Fifty-three Droughtmaster and Santa Gertrudis cross steers, varying between 380 to 450 kg, entered the trial in August 2018. A watering point and a Tru Test Remote WOW system were installed in the centre of the pivot. Pasture samples for yield, pasture composition and quality were cut weekly from cells both pre- and post-grazing. Rhodes grass hay was also available to all steers throughout the trial. After 106 days all steers were sent directly to market (1700 km) for MSA grading.

Results and discussion

Pasture: Yield >100 kg/day; crude protein >9.6%; dry matter digestibility >80%; metabolisable energy >12.2 MJ/kg dry matter. *Hay:* Yield = 14 t/ha; value of hay = \$350/t.

Steer Performance: average (ave) growth rate = 0.49 kg/day; ave dressed carcass weight = 279.6 kg; ave price received = \$5.52/kg dressed weight; ave MSA index = 58.20; ave lean meat yield = 57.78%; ave p8 fat = 13mm; MSA compliant = 96%. All cattle except 2 graded as MSA, demonstrating irrigated forage can produce cattle suitable for premium beef markets. However, the cattle growth rates were low and the winter grazing system was unprofitable (returning a net loss). In contrast, the winter pasture hay production system returned a net profit.

Conclusion

Although the irrigated temperate pasture yielded well with good nutritional value, and cattle achieved MSA grading, cattle growth rates were no better than on native pastures and it was more cost effective to grow hay than to graze it as forage.

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30 | “Paddock Power”: unlocking the secrets to sustainable and profitable intensification

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Introduction

“Paddock Power” is a new project that will measure the influence of paddock area and distance to water on breeder herd performance, steer live weight gain, mortality rates, operating costs and feedbase management.

Many breeder paddocks in northern Australia are too big and under-watered to achieve optimum productivity. Large, poorly watered paddocks impact on reproduction and profitability: there’s over- and under-utilised feed (depending on distance from water), incomplete musters and limited opportunities to implement herd segregation, controlled mating or tactical pasture management.

Walking long distances out to feed erodes live weight gain and body condition. The negative impact of poor body condition on re-conception and calf survival rates further reduces productivity. Some producers speculate that high rates of calf wastage (>20%) in large poorly-watered paddocks may be caused by cows leaving newborn calves to return several kilometres back to water, thus increasing the risk of predation or dehydration.

Fencing and water development is gathering pace on large properties in northern Australia. However it is very expensive and producers tell us that they need data on potential productivity increases to better articulate the benefits to owners and financiers.

The findings will refine current recommendations on water point spacing and provide better information on where to place new infrastructure to maximise return on investment. The project will deliver a user-friendly “Paddock Power Calculator” for producers to compare the costs of different infrastructure development options, and evaluate their profitability in the context of their specific land types, cost base and livestock productivity.

Methods

By April 2021 we will:

- Collate objective data from existing commercial property records to quantify the potential impact of paddock area and distance to water on reproductive performance and calf wastage.
- Make initial assessments into quantifying the impact of reducing paddock area and/or improving watered area on reproductive performance and calf wastage via trials of commercially managed beef cattle.
- Deliver preliminary recommendations for cost-effectively increasing reproductive productivity via paddock development.
- Complete the development of the “Paddock Power Calculator”, a user-friendly online tool which compares the costs and benefits of user-defined water point and fencing options.
- Seek commercial partners to contribute financially to extending the study to increase producer engagement and adoption.

Want to get involved?

Contact the authors to discuss how you could be part of this new project.

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302 Business Improvement Strategies of Pilbara and Kimberley Pastoralists

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Introduction

In 2015, the Department of Primary Industries and Regional Development's Northern Beef project implemented an incentive-based Business Improvement Grants (BIG) program. The program assists commercial cattle producers in the Kimberley and Pilbara pastoral regions to enhance their competitiveness and growth prospects by connecting them with professional business advice and mentoring support. The program also facilitates mentoring and builds capacity of Department officers to develop trained staff within the northern beef industry.

The program reimburses approved applicants with up to \$25,000 (excluding GST), including up to \$10,000 to engage a consultant to review current performance and develop a business plan with two annual reviews following, and up to \$15,000 to implement key business improvement strategies as identified in the business plan.

To date, 68 family, corporate and Indigenous pastoral enterprises have participated in the program, utilising the grant in a range of business improvement areas.

Results

Focus areas for improvement strategies have been ranked from highest to lowest to show the different areas pastoralists chose to invest their \$15,000 grant funds:

- Water infrastructure (19%): tanks/troughs, remote water monitoring system, water medication and associated infrastructure.
- Nutrition consultancy or trials (19%): rangeland rehydration consultancy and trial, early weaning trial, FNIRS for diet testing, cut and carry vs stand and graze economic modelling.
- Weigh equipment (14%): weigh bars, crush and infrastructure to allow for recording system.
- Herd recording software (14%): software to record herd data, movements and benchmarks.
- Other consultancy (12%): family succession planning, station land use planning.
- Staff development (10%): stock handling school, conferences, financial governance training.
- Fencing and yard infrastructure (6%): breeder segregation, resting rangelands, curved race.
- DNA testing (4%): testing for undesirable traits and testing for polledness gene.
- Pain relief (2%): Pain relief trial for dehorning and castrating weaners.

Discussion: Focus on fundamentals or venture into innovation?

The BIG program provides pastoralists the opportunity to pursue a low-risk investment to trial a new business improvement strategy. It also offers pastoralists the freedom of choice to align their chosen business improvement with their professional business plan.

Investment choices reflected a number of factors, including the developmental stage of the enterprise, the risk profile of the pastoralist and the guidance of their consultant. For some pastoralists, new technologies to improve efficiencies were considered to be the greatest return on investment while for others, it was opening up new country to access for grazing.

Participant feedback indicated that as a result of the consultation process, their reimbursement was applied toward a different strategy than the one they had originally envisioned.

The value of taking the time to plan and review business operations, as opposed to purely working within it, has been a major outcome of the program. In an occupation where business owners and managers are required to possess an extensive skill set, the use of external consultants and mentors has been invaluable, planting the seed for paradigm shifts in pastoral operations.

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303 The “Twilight” effect – a new strategy for pastoral engagement

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Introduction

In 2018 the Northern Beef Development (NBD) project launched an extension activity known as “Twilight forums” to provide a highly effective mode of engagement that delivers targeted information to pastoralists in the Kimberley and Pilbara regions of Western Australia that fits with the rhythm and intensity of the dry season pastoral operations.

The success of the Twilight forums lies in the design, which utilises three of the five models of the Coutt’s matrix of extension model (Coutts and Roberts 2003). The forums utilise the extension models of Information Access, Personalised Consultant and Programmed Learning to facilitate capacity building.

Methods

The forums are held at a centrally located station, with attendees invited who are located within a three-hour traveling distance surrounding the host station. Two to three key speakers are engaged to present a mix of theoretical and practical sessions. The guest speaker presentations are held in the afternoon and are coupled with an evening meal following the presentations. The presenters work both individually with the host stations as well as with the attendees at each forum. This provides a relaxed atmosphere for further dialogue facilitating peer-to-peer knowledge exchange and discussion, all completed on a centrally located pastoral station. Feedback forms completed by participants at the most recent round of forums held in April 2019 stated that 98% of attendees would attend more events held on local stations.

Information Access extension is achieved by tailoring the forums to their respective region. The theme of the sessions are set by the NBD team using input from stakeholders to deliver content that is relevant and desired. Stakeholders can access information delivered to them within their local district to minimise non-productive time, travelling the large distances to attend activities.

The Twilight forums allow host stations the opportunity for one-on-one work with the key speakers. This Personalised Consultant model interaction is also encouraged during the latter stages of the event over a meal with other participants. Participants have access to key speakers free of charge while at the event. The interactions encourage network building and facilitate the opportunity for participants to further their interactions with the key speakers, utilising their expertise.

Engaging pastoralists at a Twilight forum and offering support or discounts to access future scheduled learning opportunities is an avenue to facilitate Programmed Learning. Adoption of the content delivered at the twilight forums is captured through event feedback forms, and targeted follow up interactions between NBD team members and stakeholders.

Conclusion

Twilight forums are a highly successful extension tool that have been developed by the NBD team, with two rounds delivered in 2018 and one round already delivered in 2019, attendance at forums is increasing with repeat stakeholders attending as well as new stakeholders. These tailored events deliver regional, situational specific and timely information to local stakeholders. They provide an opportunity for pastoralists to engage with their neighbours, access industry leading key speakers and share knowledge.

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304 Discursive features of animal agriculture advocates

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Introduction

The general public is generationally and geographically removed from agricultural production, yet as influential as ever with regards to its ability to impact the operating conditions of the animal agriculture industry (Potard 2015). To date, the agriculture industry has focused research and extension on how to educate the public about animal agriculture and persuade them to support the industry's practices and policies. However, little work has investigated the language they use to accomplish these goals, especially in terms of how language affects not only their communication efforts, but also the industry as a whole.

This study sought to develop an understanding to how three key participant groups in the animal agriculture industry (experts, professional communicators, and agricultural advocates) use discourse and language to (1) establish a person or organization's authority and credibility in animal agricultural conversations, (2) explain opposition to animal agriculture, and (3) articulate ideas to best present and justify their arguments to the wider public. Ultimately, the study sought to understand how language signalled underlying beliefs about hierarchies of authority, credibility and expertise within the conversation.

Methods

A Critical Discourse Analysis (CDA) (Fairclough 1989; Fairclough & Wodak 1997) was applied to investigate how language was being used to develop, maintain, and reproduce positions of authority and credibility amongst participants in the animal agriculture debate. Ten semi-structured interviews were conducted with three main participant groups: Scientists/academics, Professional communicators, and Agricultural advocates. The researcher analyzed the text both collectively, by interest group, and by individual case.

Results

The discursive practices of the participants functioned to ultimately undermine and delegitimize the role of the public and individuals and groups opposed to animal agriculture. Simultaneously, the participants positioned the industry and its constituents as the only authoritative and credible voices in the animal agriculture conversation.

Discussion

The discursive features of animal agriculture advocates are likely to be prohibitive to achieving the goals of agricultural communication activities. Those communicating on behalf of the animal agriculture industry should become more aware of how their beliefs, values, and ideologies impact the discourse from which they are operating, as well as how their communication is functioning.

This research was undertaken from a critical inquiry perspective, shedding light on some of the power structures inherent between the animal agriculture industry and the general public. Others undertaking agricultural sociology and related research should consider doing so integrating a similar theoretical perspective to continually challenge the assumptions and conditions under which the industry operates.

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305(a) Assessing the potential of Automated Livestock Management Systems I. Learning to Walk-over-Weigh

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Introduction

Automated livestock management systems (ALMS), including Walk-over-Weighing (WoW), have the potential to provide accurate animal production data while reducing handling costs for beef producers (Swain 2017). However, information on the time, effort and activities required to implement these systems are mostly anecdotal. This trial monitored the implementation of a WoW system with a naive group of heifers, and evaluated its accuracy of data collection.

Methods

During the 2018 summer (Nov-Dec) 37 Belmont Red weaner heifers (184kg ± 34.5) located at Belmont Research Station, Central Qld were trained for use of WoW. The heifers had only received minimal weaner training and were naive to WoW systems. A single watering point in the 15ha paddock was gradually enclosed over 3½ weeks pre-training and fully enclosed on Day 1. Use of the WoW system was monitored via autonomously recorded RFID data and paddock observations. Training included encouragement mustering to a wing leading from the WoW entry and offering supplement (OrganicFlo 10NP+Phos, Wilmar Sugar Aust. Ltd, Sarina). Static weights (after 2-3hr curfew) were collected monthly.

Results

Most heifers (73%) were using the WoW system by Day 3. However, there was no increase in usage by Day 11, despite seven encouragement musters on four different days. Usage increased to 97% when supplement was offered from Day 12 and by Day 15 heifer usage was 100%. Static and weekly average WoW weights (Table 1) were highly correlated.

Table 1. Static and WoW weights of heifers in the ALMS training trial.

ALMS training week	<i>n</i> Static wts	Static ave. LW (kg)	SD	<i>n</i> WoW wts	WoW ave. LW (kg)	SD	R
Pre-training	37	184	34.5	-	-	-	-
2	37	203	37.4	29	221	32.2	0.95
6	37	215	41.8	25	230	31.9	0.98

Discussion

The heifers were considered trained after 15 days, with 3½ weeks pre-training. Autonomously-collected WoW data can be as accurate as static weighing. Our work supports anecdotal information regarding the implementation a WoW system with a naive beef herd and its ability to provide accurate animal production data while reducing handling costs.

References

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305(b) Assessing the potential of Automated Livestock Management Systems 2. Auto-drafting from Walk-over-Weigh

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Introduction

Automated livestock management systems (ALMS) including Walk-over-Weighing (WoW) and auto-drafting have the potential to provide accurate animal production data for beef producers, enabling them to execute management decisions while reducing handling costs (Swain 2017). This trial monitored the implementation of an ALMS and evaluated its accuracy and efficacy.

Methods

During the 2018/19 summer (Dec-Mar) 37 Belmont Red weaner heifers (184kg ± 34.5) located at Belmont Research Station, Central Qld were trained to use ALMS. Training included mustering to a wing leading from the WoW entry, and offering supplement (OrganicFlo 10NP+Phos, Wilmar Sugar Aust. Ltd, Sarina). The auto-drafting gate, located after the WoW platform, was triggered automatically as RFIDs were read. Mis-drafts were identified by analysis of entry and exit RFID records. Static weights were collected monthly.

Results

Although nearly 90% of heifers were using the auto-drafter by Day 5, rain and paddock surface water on Days 7-12 disrupted use. Usage ranged from 32-87% during Days 13-36 with 12 encouragement musters. Removal of four heifers on Day 37 resulted in almost 100% usage each day from then on. From Days 38-96 there were 20 mis-drafts (<1%). Static and WoW weights (Table 1) were highly correlated.

Table 1. Static and WoW weights of heifers in the ALMS training trial.

ALMS training week	<i>n</i> Static wts	Static ave. LW (kg)	SD	<i>n</i> WoW wts	WoW ave. LW (kg)	SD	R
6 (Day 16 [#])	37	215	41.8	25	230	31.9	0.98
9 (Day 37)	37	240	43.3	31	251	38.4	0.99
13 (Day 65)	33	251	43.0	33	258	44.7	1.00
17 (Day 93)	33	267	45.5	33	272	47.7	1.00

[#] Day of auto-drafting training.

Discussion

Auto-drafting from WoW was an effective way to draft cattle and comparison of static and WoW weights show reliable weekly data is readily accessible without the need to muster. The results indicate the potential of AMLS technology to help producers strategically manage beef herds with reduced stock-handling.

References

Swain DL (2017) A paddock based digital hub for automated cattle monitoring and management. P.PSH.0845. Final Report. Meat and Livestock Australia Ltd. Sydney. (Under review).

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306 Assessing the potential for Automated Livestock Management Systems 3. Using Walk-over-Weighing to estimate calf birth weight

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Introduction

Calf birth weight has been linked to dystocia problems in numerous studies and therefore is recorded by many seedstock producers. However, due to paddock size and the labour required, the level of recording is far less within northern seedstock operations. Walk-over-Weighing (WoW) records the weight of cattle in a paddock situation and can determine the calving date based on weight loss at parturition (Menzies et al. 2018). The aim of this study was to use WoW weights between branding and weaning to generate estimated birth weights (EBW) and compare with actual birth weights (ABW).

Methods

A group of 40 Tropical Composite cows and calves and 40 Brahman cows and calves were monitored in separate paddocks from calving to weaning. The birthdate, ABW, maternal parentage and sex of newborn calves was recorded daily. Walk-over-Weighing data was recorded between branding and weaning and although both cow herds had been conditioned to WoW the calves were not given any training. The Composite calves had 3 static weights recorded prior to branding and all calves had weaning weights recorded. Three methods were assessed to estimate BW using either linear, logistic regression or combined linear and logistic regression. Using the static and WoW weights and the known calving date, the y-intercept generated from each method was extracted as the EBW. The absolute relative error was calculated using the formula $[(EBW - ABW) / ABW] * 100$.

Results

For the Tropical Composite calves the linear and logistic regression models produced very similar results with approximately: 30% of calves having EBWs less than 10% of the ABW; 45% within 10% and 30% of the ABW and 25% greater than 30% of the ABW. For the combined regression model 65% of calves had EBWs less than 10% of the ABW and only 4% were greater than 30% from the ABW. For the Brahman calves the linear model performed slightly better than the logistic regression but both groups had approximately 80% of calves with EBWs greater than 30% from the ABW. In addition, the logistic regression model was only able to generate growth paths for approximately 48% of calves. The combined linear and logistic model resulted in 40% of calves within 10% of the ABW but 60% were more than 30% from the ABW.

Discussion/Conclusions

The Tropical Composite data highlighted the advantage of having static weights to assist the models with many more animals having EBWs that corresponded with the ABW. Future research will investigate if a longer data collection period, a greater percentage of calves being recorded per day or additional training could increase the accuracy.

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307 Peer to peer forage budgeting in the Upper Burdekin Rangelands

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Introduction

Poor management of stocking rates has a direct correlation to land degradation which is one of the main contributors to poor quality runoff water. As the seasons are highly variable, stocking rates require regular adjustment. If the country is set stocked for an average season, it will be overstocked in 50% of years. This style of management causes land condition to slide to category B. Failure to adjust stocking rates on degraded country increases the frequency of overstocking to 70 to 80% of years, with feed shortages, high mortalities and high supplementary feeding costs incurred almost annually. Grazing land then declines to land condition C or D.

Forage budgeting is a critical tool in northern Australia to ensure adequate end-of-dry season pasture cover levels are retained. High pasture cover promotes rainfall infiltration and good pasture growth the following season. An objective method of determining dry season stocking rates based on available feed in April or May, sets the property up for a dry season that is low stress for the people, finances, land and cattle. It allows for the planned marketing of cattle and the adoption of a wide range of land management practices.

The concept of basing dry season stocking rates on an annual forage budget has been promoted for several decades. However uptake by industry has been poor. Facilitating a peer to peer forage budgeting service by the Dalrymple Landcare Committee based in Charters Towers, has increased the adoption with 30 Upper Burdekin properties registering to have a fellow grazier assist with developing a forage budget in 2019.

This paper highlights the evolution of this free service, grazer participation and benefits for the whole beef business, including herd performance, and environmental & financial outcomes.

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308 Development of Excel and Simple Record Keeping Workshops for Producers

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Introduction

In late 2017 a new workshop was developed to train and encourage producers to increase electronic record keeping activities for their business's, linking to the Grazing Best Management Practice (Grazing BMP) program to encourage the uptake of good farm management practices. These workshops aimed at building human capability for a sustainable industry by providing producers with simple electronic tools to develop and refine their business record keeping practices.

The workshops were targeted towards producers with nil or little computer experience and who had no or paper based recording activities. The workshop format covered basic navigation and operation of the excel program, understanding and using simple formulas for analysis of property data, the importance of record keeping for quality assurance practices and on farm productivity, and developing individual producer recording spreadsheets relevant to their production enterprises.

So far five workshops have been run covering South East Queensland and the South, Central and North Burnett regions, based on producer demand. More workshops are planned in the Baffle and Kolan regions this year.

Due to the success of the workshops in the South region DAF staff in the Central and Northern regions have workshops planned for those areas commencing in May this year.

Producer Record Keeping Demands

The main areas producers were focused on electronic recording were:

- Cattle weights
- Breeder records – mating, pregnancy rates, calving, weaning
- Cattle treatments
- Supplementary feeding
- Chemical usage / storage (both livestock and land)
- Overall cattle management – sales, purchases, movements, deaths
- Cropping
- Forage budgeting
- Financial

Workshop Results

Ninety percent of producers who attend the workshops found it extremely useful for their business and majority requested refresher and advanced follow up workshops to continue to develop their skills in record keeping.

Practice change outcomes

90 percent of producers who attended the workshop said they believed they could now develop their own excel property recording records.

100 percent of producers who attended the workshop said they intended to implement excel recording for their property records after attending the workshop.

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309 Legumes preferred by graziers in the Brigalow Belt

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Introduction

Incorporating legumes into grass pastures has been identified as the best way to increase productivity of grass-only pastures. Despite the large area of suitable land and years since being cleared there is not a high level of successful adoption of legumes in pastures in the Brigalow Belt bioregion of central and southern Queensland (Peck et al. 2011). This shortfall inspired a project setting out to provide information to graziers and their advisors to enable them to more reliably establish legumes into grass pastures to increase productivity. This paper investigates which legumes graziers indicated they will use in the future, and where.

Methods

Thirteen grazer workshops were held in the Brigalow Belt concerning best management practices for legume establishment and management. At the beginning of each workshop, graziers discussed which legumes they have tried. As part of the workshops, graziers developed a Legume Management Action Plan including which legume they intend to sow in future.

Results

In total, 212 graziers participated in workshops between October 2017 and September 2018, managing 735,636ha of sown and native pastures and 144,986 head of cattle. Graziers have tried 32 different legume species and going forward the Action Plans of 92 graziers indicated they intended to use 16 different species. The graziers planning to sow legumes in the near future indicated that they were interested in sowing into the heavier soils (60% clay soils, 26% loam soils), which are generally more productive.

Discussion

The wide range of legumes that graziers have tried cover a range of soils and rainfall zones. Graziers intend to sow into more productive soils that are likely to provide better return on investment. The most commonly selected legumes (74% of Action Plans) were Caatinga stylo (*Stylosanthes seabrana*) and Desmanthus (*Desmanthus* spp.) that are adapted to clay and loam soils and planted either on their own or together with other legumes. Leucaena was the next most preferred legume at 9% of Action Plans. Other legumes selected include burgundy bean, siratro, shrubby and fine-stem stylo, and some temperate legume species (e.g. medics).

Conclusion

Interest in legume pastures is increasing for producers within the Brigalow Belt and there will likely be an increase in the number of paddocks sown with desmanthus, Caatinga stylo and leucaena in the coming years.

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310 Grazier practice change on legume pasture establishment and management

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Introduction

Incorporating legumes into grass pastures has been identified as the best way to increase productivity of grass-only pastures. The area successfully established with legumes is estimated to be very low in the Brigalow Belt bioregion of central and southern Queensland (Peck et al. 2011), which has inspired a project setting out to provide the information and guidance to producers to enable them to successfully establish legumes into their pastures and increase productivity. This paper discusses grazier intentions for practice change to-date.

Methods

Thirteen grazier workshops were held in the Brigalow Belt bioregion between October 2017 and September 2018 concerning the best management practices for legume establishment. At the end of each workshop, the participants completed evaluation surveys to provide feedback on learnings from the day including their biggest learning and what changes they would implement in their business.

Results

In total, 212 people participated in the workshops, managing 735,636ha of sown and native pastures and 144,986 head of cattle. Workshop participants indicated they intend to sow a total of 8,276ha to legumes within 12 months and 66,347ha within five years. Table 1 shows the response to the question “Do you intend to change legume establishment technique(s) into the future compared to previous sowings?” taken from 162 surveys completed.

Table 1 Practice change intentions when establishing new legume pastures.

Responses 'Yes' (n=118)	
<input type="checkbox"/> Seedbed preparation, weed control and fallowing	36%
–Establish legume in strips	19%
–General changes (e.g. use agronomist, plan better)	17%
–Improve sowing techniques and/or rhizobia inoculation	14%
–Change species/varieties, test soils or apply fertiliser	11%
–Improve grazing management	3%

Discussion and Conclusion

The most popular change was preparing the seedbed, undertaking weed control and or introducing a fallow period (36%). Planting strips of legumes into existing grass-only pastures was the next most common (19%) as graziers see it as an option allowing them to graze the paddock while still preparing a seedbed to sow. The number of hectares to be sown in the next 12 months compared to the total area of pastures (sown and native) represents approximately 1.1% and over the five years approximately 9% of the total area managed by the workshop participants. This response indicates an ongoing interest from graziers in improving productivity through legumes.

References

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3 | Engaging with the FutureBeef eBulletin

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Introduction

FutureBeef is an important partnership between Queensland, Northern Territory and Western Australia agricultural departments and Meat & Livestock Australia. It provides a coordinated approach to the delivery of online information and industry engagement for the northern beef industry. This paper focuses on the success of the FutureBeef eBulletin (an electronic newsletter).

Methods

The FutureBeef eBulletin commenced in April 2012, with just 26 subscribers. It is normally published on the first Tuesday of each month. The purpose of the eBulletin is to highlight relevant and timely information and events for the northern beef industry. Articles are sought from FutureBeef partners as well as other third parties with relevant northern beef industry information. Mailchimp (www.mailchimp.com) is used to produce the FutureBeef eBulletin.

Results

As at 16 April 2019 the FutureBeef eBulletin had 4621 subscribers. This has increased by over 20% just in the last 12 months. The average open rate for the FutureBeef eBulletin is 33.8% with a click rate of 8.6% over the last year (Fig. 1). Open rate is how many subscribers opened the eBulletin. Click rate is how many people clicked on a link for more information or image within the eBulletin.

Fig. 1. FutureBeef eBulletin open and click rates for the past twelve months.

— FutureBeef open rate. — Industry average open rate. — FutureBeef click rate.

Discussion

Compared to the agriculture industry average open rate of 23.1% and click rate of 2.7% (Mailchimp, 2018), the FutureBeef eBulletin is performing extremely well. This is most likely due to the relevant and timely articles as well as recognition and trust in the FutureBeef brand. As a result, northern beef industry professionals should consider promoting their work, information and events via the FutureBeef eBulletin. Submissions can be made to info@futurebeef.com.au.

References

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3 | 2 FutureBeef webinars—a platform for success

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Introduction

FutureBeef is an important partnership between Queensland, Northern Territory and Western Australia agricultural departments and Meat & Livestock Australia. It provides a coordinated approach to the delivery of online information and industry engagement for the northern beef industry. This paper focuses on the success of the FutureBeef webinars (online seminars).

Methods

FutureBeef commenced running webinars in November 2012. People can either participate in the live webinar or watch the recording at a later date. GoToWebinar (by LogMeIn) is the software used by FutureBeef to host the webinars (www.gotowebinar.com.au).

Results

FutureBeef has hosted almost 60 webinars on a wide range of topics, with various partners and presenters. A total of 9489 people have registered for these webinars and 3945 participated in the live event, with an average participation rate of 67 people per webinar. From the completed feedback forms the participants rated the webinars as 7.9/10 for improving their knowledge and 8.4/10 for satisfaction with the webinar overall.

Fig. 1. FutureBeef webinar registrations and attendance.
Total registered. Total attended.

Discussion

Overall FutureBeef webinars have been a highly successful platform to get relevant and timely information out to those who need it, without the need to travel or a whole day away from the business/property. Alternatively people can also watch a recording of the webinar at a time that suits. Northern beef industry professionals should consider using webinars as a cost-effective method of promoting timely and relevant information. Expressions of interest to present a webinar can be sent to info@futurebeef.com.au.

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313 Grazier ‘dry season’ decision support tools

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Introduction

Deciding how many stock to run can be difficult, especially in the face of wide seasonal variation. Some graziers seemingly sail through droughts and some struggle with long and stressful feeding programs. What makes the difference? Everybody’s situation is different and there is no one size fits all. Having a business and ‘grass farmer’ approach where stock numbers and grazing management is focused on maintaining or improving land condition could help in many situations. Perhaps also moving early to adjust stock numbers in poor pasture growing seasons.

The “Wambiana” grazing trial and case studies of successful graziers such as “Werrington” are useful reading as are Alan Lauders “Carbon Farming” blogs promoting carbon flow and wet season spelling.

In addition, a suite of web sites, training workshops and excel tools, as listed below to name a few, can assist in short and long term stocking rate, destocking and feeding decisions.

Assessing carrying capacity (land, rain, pasture and economics)

- The Long Paddock: e.g. FORAGE reports; land type, rainfall, pasture growth; long term carrying capacity calculator to be released 2019. <https://www.longpaddock.qld.gov.au>
 1. ‘CliMate’: user friendly site for historic rainfall and probabilities. <https://climateapp.net.au>
 2. Training workshops: e.g. EDGE - Grazing Land Management and Grazing Fundamentals, RCS, Holistic Management, Stocktake.
 3. Farm economics tools: e.g. Testing Management Options, Breedcow-Dynama, and Paddock margin calculator.

Assessing pasture supply until next summer or autumn

1. Forage budgeting: Four YouTube clips by Col Paton <https://futurebeef.com.au/forage-budgeting-videos/>
2. Stocktake workshop: <https://futurebeef.com.au/workshops/sustainable-grazing/stocktake-balancing-supply-demand/>
3. Dry season forage budget excel calculator

Assessing options (excel tools, DAF 13 25 23)

1. Agistment: estimate cost benefit of using agistment
2. Production feeding: economics of supplementing, production feeding or lot feeding stock
3. Sell versus feed: compare cost of feeding stock versus selling and buying back (draft)
4. Marketing options: compare returns if selling through works, yards or paddock sale
5. Costing nutrients: cost energy and protein of feeds and supplements
6. Ration Calc: calculate rations, compare supplements, cost nutrients, tally feeding quantities and costs, compare animal requirements with feed intake

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314 Grazing Best Management Practice (BMP) enhances the James Cook University (JCU) veterinary students' final year beef experience

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Introduction

The Department of Agriculture and Fisheries (DAF) in the Burdekin Catchment has been collaborating with James Cook University (JCU) in Townsville to provide fifth year veterinary students a grounding in extensive beef production. This collaboration value adds to the students' knowledge and understanding of the Australian Beef Industry and production systems thus building the capacity of a new veterinarian. It also meets the Grazing BMP and Extension Support team's objective of supporting stakeholders such as JCU to increase the knowledge and skills required to better service the grazing industry and meet ReefPlan objectives.

Method

Since 2018, the fifth year students have participated in a beef experience session. Each year there are three rotations made up of four sessions. This ensures maximum group size is no more than eight students, thus maximising the involvement of each student in a particular group. For the period from July 2018 to the present approximately 90 students have been engaged in the process, contributing to the overall engagement targets of the Grazing BMP Extension and Support project.

Discussion

The fifth year beef experience encompasses a range of activities focussed on veterinary and production aspects of the beef industry. The aim of the collaboration is for the students to think about their role as a veterinarian and how they can influence or drive practice change to improve the productivity of a beef business. The students need to think from an enterprise production view, rather than just from a health or medicine view, therefore bringing the whole system into an integrated mindset.

The students have the opportunity to listen to presentations ranging from Biosecurity Officers, grazing land management officers and Landcare staff. The session concludes with an overview of Grazing BMP so that students are aware of how the voluntary self-assessment process gives beef producers the opportunity to look at best management practice and benchmark their business in order to identify strengths and weaknesses. Reviewing this process also provides an opportunity for the students to consider the type of advice and support they may offer to grazing businesses in their future role as a veterinarian to enhance best practice management.

It is important that these future veterinarians, many of whom are not from rural or grazing backgrounds, have an understanding of the best management practices that a grazier needs to undertake to be profitable, productive and sustainable. Graziers need to be able to show due diligence to animal health and welfare as well as environmental stewardship. Through the program, students have also accessed the DAF developed Breedcow Dynama Software tool to run a trading scenario, looking at the variables that impact on profit when buying and selling livestock. Staff from Biosecurity Queensland have assisted by providing background information to students on animal welfare and biosecurity requirements when they visited the Dalrymple Saleyards.

366 Out with old and in with the new: new methods for more accurate grazing land management (GLM) land type mapping.

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Introduction

Grazing Land Management (GLM) land types (land types hereafter) of Queensland are described in terms of their landform, woody vegetation, expected pasture composition and broad soil characteristics, limitations to use of the land and grazing management recommendations. More than 220 land types from 15 GLM regions in Queensland have been described. Land types are used extensively by the Queensland Department of Agriculture and Fisheries (DAF) in a suite of extension programs, for property mapping, assessing land condition, bio-economic modelling and to communicate with graziers. The Queensland Department of Environment and Science (DES) use land types in their grazing land management decision support tools (www.longpaddock.qld.gov.au). The accurate mapping of land types is essential for providing grazing land management information based on the best science available. A review and update of the land types incorporating new data and new methods was undertaken.

Methods

We used Regional Ecosystems (RE) mapping data as the base layer to spatially define the land types by associating each RE polygon to a land type. The most current version RE v10 (2018), which included a number of newly described RE, primarily in the Southern Gulf region, was used. We ensured that each RE was matched with the GLM region that it was physically located in and a land type from that region. We then applied an index of wet season pasture growth to split RE from southern Queensland into their different GLM region land types. We also applied agro-climatic zones to more accurately divide RE that were spatially widespread into their GLM region land types. To ensure that our RE to land type matches were accurate we engaged multiple teams of regional experts to review and validate our RE to land type associations.

Application

The application of these new methods has improved the accuracy of land type mapping to better reflect the 'on ground' land type. Validation has been completed in the Mitchell grass, Channel country, Mulga and Southern Gulf GLM regions. Regular updates of the spatial data will occur as other GLM regions are validated. GLM land type spatial data is available now (V5.4), for download on QSpatial, the open data portal, and will be on Queensland Globe in June 2019. Feedback on the accuracy or suggested corrections is welcomed to be emailed to: GLM_landtype_map@daf.qld.gov.au.

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315 Alice through the looking glass—comparison with beef cattle benchmarks

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Introduction

The reproductive performance of commercial beef breeding females in northern Australia was described and benchmarked for 4 country-types in the 'CashCow' project (MLA 2015). For the Northern Territory's Alice Springs district, 'benchmarking' has occurred through pastoral industry questionnaires and recording of cattle herd performance on individual properties. The case study in this paper uses benchmarks to discuss potential for improving breeding herd productivity in the Alice Springs district.

Methods

Cattle performance on Old Man Plains Research Station (OMP), 25 km south-west of Alice Springs, was recorded over 6 years (2009/10 - 2014/15) in a group of mixed-aged Droughtmaster females ('OMP group'). Management included controlled-mating from December to February, and pregnancy testing by rectal palpation in May. The calves were weighed and weaned at 3-5 months of age. Herd indices for reproductive performance (pregnancy, foetal/calf loss, weaner production) were compared to those reported in the 'CashCow' project and on properties in the Alice Springs district.

Results and discussion

Reproductive performance indices in the 'OMP group' are given in Table 1. Medians were similar to those for older cow groups on 'Northern Downs' country-type in the 'CashCow' project (MLA 2015).

Table 1. Reproductive performance of mixed-aged cows.

Performance indices	'OMP group'		'Northern Downs' country-type	
	Median	Min.-Max.	Median	25 th to 75 th percentile
Pregnancy (%)	82	65-94	82	75-91
Foetal/calf loss (%)	10.5	5.0-17.8	6.9	3.3-14.7
Weaner production (kg/retained cow)	168	151-216	163*	135-183*

*Performance of all female age-groups

High annual herd indices have been previously reported in the Alice Springs district, e.g. for conception in aged cows (97 %); for foetal/calf loss in aged cows (10.3 %); and for weaner production after good seasonal conditions (271 kg/retained cow) (Coventry 2013). Comparison of 'OMP group' indices with benchmarking of properties in northern and central Australia is qualified by possible differences in management. However comparison does highlight the range of 'OMP group' indices and the potential association with factors that can impact on performance in extensively-managed cattle herds. In the absence of standard district benchmarks, this case study demonstrates a starting point to identify such factors and their management for improved productivity of a district herd.

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316 Finding the ‘Sweet Spot’ for reproductive performance in north Australian beef herds

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Introduction

Nutrition has a dominating effect on the reproductive performance of beef breeding females, but the level of pasture utilisation required for optimal cow herd production in northern Australia is unknown. We are using existing datasets to: 1) quantify the effect of pasture utilisation rates on reproductive performance (pregnancy, lactating cows pregnant within four months, calf loss and weaning percentage); 2) improve the capacity of existing models to predict cow performance and economics of herd management; and 3) recommend management to improve cow herd performance, production and profitability while maintaining the land and pasture resource for different land types and regions in northern Australia.

Methods

We have reviewed 64 cow performance datasets from across northern Australia for their suitability for use in the project. Minimum requirements for project inclusion were:

- Individual animal data for the derivation of consistent reproduction indices across all datasets.
- Known paddock infrastructure and stock numbers by class for all animals in paddocks, for calculation of stocking rates by watered area.
- Pasture growth models for the land types in the paddocks.
- Animals were not production supplemented.
- Animal data for at least two years (preferably three years or more) to increase the likelihood of experiencing a range of utilisation rates for the herd.

Ideal datasets additionally had:

- Total standing dry matter measured in the paddocks to validate simulated pasture growth.
- Locally calibrated land type models (SWIFTSYND sites).
- Herds in one paddock all year round.

Results and Discussion

Twenty-eight datasets including 22 from the Northern Territory (Barkly, Victoria River District, Katherine/Sturt Plateau and central Australia) and six from northern Queensland (NQ) were suitable for the project. Eight were ideal. Factors that prevented more NQ datasets from inclusion included production supplementation and frequent paddock movements.

Conclusion

The data search phase of the project is now complete. Next steps include modelling pasture utilisation and calculating consistent breeder reproduction indices for all the dataset herds by year.

The ongoing funding from MLA for this project is acknowledged.

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317 Blood phosphorus depends on reproductive status in breeder cows

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Introduction

Phosphorus (P) deficiency constrains production of cattle grazing pastures on low-P soils in many northern Australian rangelands. The concentration of inorganic P in blood (Pi) in the late wet season in young growing cattle not fed P supplements, combined with estimation of diet quality from faecal analyses, provides the most reliable indication of P deficiency.

Methods and Results

Droughtmaster breeder cows in initial high P status were allocated to six paddocks (n=6 or 8 per paddock) and grazed native pasture oversown with *Stylosanthes* (soil P_B 2-4 ppm). Three paddocks were P-deficient (no supplements) and three P-adequate (fed P supplements) through two annual cycles (Miller et al. 1998). Blood Pi was measured in mid-pregnancy, mid-lactation and 4-6 weeks post-weaning. P intake was measured using P tracers and related to Pi (Fig. 1) at each measurement date.

Fig. 1. The blood Pi of breeder cows during mid-pregnancy (○), mid-lactation (▲) and four to six weeks post-weaning (■), and their diet intakes of P from both pasture and supplements during two annual cycles. The calculated P requirements were 16, 46 and 30 mg P/kg liveweight (LW) respectively.

Discussion and Conclusion

Blood Pi depends on the availability of P from both the diet and mobilized body (bone) P reserves. In these cows the relationships between blood Pi and P intake were very different during mid-pregnancy (September), mid-lactation (February) and four to six weeks post-weaning (May). Therefore the critical Pi indicative of diet P deficiency in breeders will differ depending on their reproductive status. Also the Pi of reproducing breeders is likely to be different to the Pi of young growing cattle.

Reference

Miller CP, Coates DB, Ternouth JH, White SJ (1997) Phosphorus management of breeding cattle in northern Australia. Final Report on project DAQ.093, Meat Research Corporation, Sydney.

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318 Blood phosphorus concentration may be highly variable in mixed-age breeder herds

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Introduction

Low phosphorus (P) concentrations in soils and pastures result in P deficiency of cattle in many northern Australian rangelands. The 'P-Screen' test recommends measuring inorganic P in blood (Pi) in the late wet season in 20 young growing cattle not fed P supplements, combined with analyses of faeces to estimate diet quality (McCosker and Winks 1994). However mixed breeder herds are likely to have higher variation in P status and Pi than selected small groups of young growing cattle.

Methods and Results

A herd of lactating Droughtmaster-type breeders (age 5-12 years) grazed a paddock with low P soils on Spyglass Research Facility (Charters Towers) during the wet season, mated (Jan-April 2014), and were not fed P supplements. The cows had been mated annually from 2 years of age. Blood was sampled from lactating cows ($n = 133$) on the 5 May 2014. On the 18 June 2014 the cows were weighed, body condition scored (1-5 scale) and pregnancy tested. Thirty-eight percent of the cows were pregnant. The mean [\pm standard deviation (sd)] of liveweight (LW) was 421 (± 51) kg, BCS 1.9 (± 0.5), and Pi 1.02 (± 0.545) mmol/L. Mean and sd of Pi were not affected ($P > 0.05$) by the pregnancy status. Pi was positively correlated with LW ($P < 0.01$) but LW explained little of the variation ($R^2 = 0.05$). In pregnant cows Pi tended ($P = 0.06$) to be negatively correlated with cow age.

Table 1. The 95, 90 and 80% confidence intervals (\pm about the mean) in measurement of herd Pi as the number of cows sampled increased from 10 to 120 animals and with a sd of 0.545 mmol/L.

CI (%)	Number of cows blood sampled				
	10	20	30	60	120
95	0.39	0.26	0.20	0.14	0.10
90	0.32	0.21	0.17	0.12	0.08
80	0.24	0.16	0.13	0.09	0.06

Discussion and Conclusion

Pi reflects the availability of P from both the diet (pasture and supplements) and mobilized body (bone) P. The present results show that breeders of mixed age, BCS and reproductive status are likely to vary widely in Pi which is reflecting both P intake and body P reserves. High variability in Pi will cause major sampling error when only 20 animals are measured. From other studies the sd of Pi in groups of young growing cattle of similar LW, age and history is often much lower (e.g. 0.2-0.3 mmol/L) than in this present breeder herd. In conclusion, if only 20 cows are sampled a high variation in Pi may cause substantial error when using the P-Screen test to evaluate P deficiency in mixed breeder herds.

Reference

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319 Effect of age at first calving on the incidence of calf loss in Brahman and Tropical Composite mobs in northern NT

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Introduction

First-calf heifers have the lowest fertility of any age class with low conception rates and high occurrence of foetal and calf loss, particularly in northern Australia. To increase selection pressure for early puberty, and potentially increase the number of calves a cow contributes in her lifetime, yearling mating is sometimes adopted. However, it is speculated that calving heifers at younger ages may increase the risk of calf loss, due to potential increased risk of expressing poor maternal behaviour and dystocia. This study compared the calf loss rates of mobs of Brahman and Tropical Composite heifers that have been selected for early puberty, calving for the first time at either two or three years of age.

Methods

Calf loss was ascribed to 1,264 first-calf heifers (born 2008 to 2015) using historical pregnancy, subsequent lactation and calf parentage data. Heifers were mated first as yearlings for approximately 105 days with those that did not conceive mated again in the following year. Heifers were classified as either first calving as two or three year olds based on the time of their first confirmed pregnancy. Brahman and Composite heifers calved at Douglas Daly Research Farm, until 2014 when the Composite herd was moved to Beatrice Hill Research Farm. Despite the difference in location, management was similar. The number of calf loss events for mobs (year groups) were compared using a *Poisson* regression model with number of pregnant heifers at-risk of calf loss included as an offset. Breed and age at first calving were included as main-effect terms. All analyses and model checking were performed using R.

Results and Discussion

Overall, 12.5% (10.4-14.5%) calf loss was observed for first-calf heifers and ranged between 0 and 24.5% (Table 1). Age at first calf was associated with a 5% increase in calf loss when calving at 2 years of age, when compared to first calving at 3 (14.8% vs. 9.8%; $P=0.03$). This association was independent of breed, which was not associated with calf loss ($P=0.87$).

Table 1. Calf loss rates for two- and three-year-old first calf Brahman and Tropical composite heifer mobs.

Breed	Age at first calving	No. of mobs	Av. No. of heifers per mob	Calf loss (%)		
				Average (95% CI)	Median	Range
Brahman	2	8	27.9	14.5 (10.1-18.9)	11.7	0.0-18.2
	3	8	47.3	9.7 (6.9-12.5)	8.4	4.3-19.4
Composite	2	8	50.0	14.9 (11.4-18.5)	16.5	3.7-24.5
	3	7	23.3	10.0 (6.4-13.6)	8.3	0.0-18.2

It is acknowledged that a shortcoming of this study is the potential selection bias from all heifers being exposed to bulls as yearlings, resulting in a non-random sample of heifers first calving as three years of age, as well as the potential confounding effects from different locations. However, the current findings appear to suggest that calving heifers at two years of age is associated with increased likelihood of calf loss. Further research to establish causation is warranted to evaluate management practises that can be modified to mitigate their effects and maximise the number of calves a cow contributes in her lifetime.

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320 Plant Available Phosphorus map of Queensland Grazing Lands- Stage I

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Introduction

The Soil and Land Resources Group within the Department of Environment and Science (DES) has been contracted to produce 'plant available phosphorus' (plant available P) and 'critical P trigger' maps and associated GIS datasets of the surface soil across Queensland's Grazing Lands. Department of Agriculture and Fisheries (DAF) and Meat and Livestock Australia (MLA) funded the project to improve the existing knowledge of plant available P for Queensland's grazing lands, using innovative Digital Soil Mapping (DSM) processes.

Existing knowledge of the North-East and Central Queensland Grazing lands consists of 1:1 000 000 scale map produced in 1994 which utilised 28 existing grazing land types (Ahern et al. 1994). The connection between plant available P and pasture legume responses have a significant impact on animal production and economic returns, but the understanding of plant available P is poorly understood spatially.

Methods

It is proposed to map Queensland grazing lands in six stages (2019-2021). Stage 1 involves modelling Queensland's most productive grazing land including areas within Fitzroy, Wide Bay- Burnett, Southeast Queensland and Darling Downs.

The project uses phosphorus data within the Queensland Government's Soil and Land Information (SALI) platform. Soil P data will be augmented through analysing archival soil samples, along with a targeted sampling regime targeted at addressing gaps in soil P knowledge. Soil sampling will be done in conjunction with DAF officers and graziers.

The DSM process will involve a machine learning based approach to map plant available P across Queensland. It will use available phosphorus data and a selection of environmental covariates that relate to plant available P to produce a raster dataset with individual pixels approximately 1 ha in area. The project collaborates heavily with DAF staff and their expertise regarding pastures, legumes, P supplementation and P interactions.

Results

The project will produce GIS datasets and maps of plant available P and small-scale critical P trigger map across Queensland's grazing lands. At approximately 1 ha resolution, the products will assist DAF pasture agronomist and extension officers at a property scale. Plant available P mapping is based on Colwell P analyses, while the trigger map is based on pasture critical Colwell P thresholds and the Phosphorus Buffering Index of various soils. At this conference we present the plant available P map for Stage 1 which includes some of Queensland's most productive grazing land.

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32 I Phosphorus and zinc fertilization effect on the first season growth of three annual medic cultivars

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Introduction

Annual medics (*Medicago* spp.) are adapted to neutral to alkaline soils and are widely sown in southern Australia and southern inland Queensland (Bolland, 1997). Phosphorus (P) is the most commonly limiting nutrient for legumes growth in southern Queensland, and zinc (Zn) deficiency for grain production is also common in this region. However, little is known about the effect of fertilization with these nutrients on medic production in this region.

Materials and methods

This experiment was conducted on an alkaline Vertosol located near Wandoan (with 7.0 mg of Colwell P/kg and 0.17 mg of Zn/kg at 0-10 cm). The trial design is a factorial composed of 3 medic cultivars (*Medicago truncatula* cv. Jester, *Medicago orbicularis* cv. Bindaroo Gold and *Medicago polymorpha* cv. Scimitar) with 5 levels of P fertilization (0, 5, 10, 25, 100 kg of P/ha) with an additional 2 treatments where Zn was applied (10 kg of ZnSO₄/ha) with the lowest and highest rate of P (i.e. 0 and 100 kg of P/ha). Each treatment was replicated 3 times in a randomised complete block design with 5 x 10 m plots as experimental units. Phosphorus and Zn fertilizers were applied in January 2018 and plots were sown in May 2018. Ground cover was assessed by imaging a standardised quadrat (0.7m x 0.7m) at a fixed and marked location using a digital SLR camera (EOS 550D, Canon, Tokyo, Japan). Images were analysed using the 'trainable Weka segmentation' machine learning toolkit (v3.2.29) available in ImageJ (Eibe *et al.* 2016). At the end of the growing season, biomass production was measured by direct harvest and soil samples were collected from the same area previously used for ground cover evaluation. Seed production was harvested from 2 representative locations (0.3m x 0.3m) in each plot, using an adapted vacuum harvester.

Results and conclusions

Phosphorus increased the growth rate of all cultivars tested. At 107 days after sowing, ground cover was 2.3 times greater ($P < 0.001$) in plots that received 100 compared to 0 kg of P/ha. Bindaroo Gold and Scimitar showed greater ground cover than Jester ($P < 0.005$; 17, 17 vs 13%). Plots fertilized with Zn showed a tendency ($P = 0.06$) for greater ground cover when compared to treatments without additional Zn. Total biomass production data was fitted to a general Gompertz model with 90 and 95% of maximum production occurring at Colwell P of 25 and 30 mg P/kg respectively; this response was independent of the cultivar. Seed production and seed weight showed significant interaction ($P < 0.005$) effects between P rates and cultivars. Scimitar was the only cultivar that significantly increased seed production in response to P fertilization. P fertilization increased seed size in Scimitar but decreased it in other cultivars. Zinc fertilization did not affect seed or biomass production of any cultivar.

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322 Design and development of a biological implant for long term intravaginal retention in cattle

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Introduction

Most studies investigating the use of intravaginal devices in cattle have focused on the development of controlled internal drug release (CIDR) and progesterone releasing intravaginal devices (PRID). These devices are placed for up to 18 days duration for the specific purpose of manipulating the oestrous cycle. There is minimal information on a multipurpose device that could be retained intravaginally for long-term use in non-pregnant and pregnant cattle, with only one study investigating the use of an intravaginal temperature transmitting device in 18 non-pregnant Holstein heifers for 107 days. The aim of this project was to design and develop an intravaginal implant able to accommodate varying technologies, that would not adversely affect the cow, or pregnancy and can remain within the vagina for at least 6 months. Such a device would be useful to carry sensors like thermometers, XYZ accelerometers, vaginal electrical resistance sensors, micro cameras, pedometers, and transmitters.

Materials and methods

During development, consideration was given to the following points: 1) The intravaginal device should not interfere with vaginal drainage; 2) The intravaginal device should not place significant, constant pressure to any single point of the vaginal mucosa to prevent pressure necrosis; 3) The intravaginal device should have minimal footprint on the ventral vaginal floor to avoid impairment of vaginal drainage, and also reduce any potential adverse effects on the urethral opening.

A prototype was developed consisting of a standard central core to house sensors and battery, and a separate retention module. Mathematical modelling was performed to determine the ideal length and flexibility of the arms on the retention module to reduce the possibility of pressure necrosis within the vagina. Plastic injection moulding techniques using acrylic were utilised to develop the initial prototypes, however due to strength and moisture condensation issues, the material was replaced with ultrasonically welded polycarbonate. The final prototype was initially trialled with a loaded cargo pod for 4 weeks in 5 non-pregnant cows, with 100% retention and no adverse effects. These were inserted into the cranial vagina using a custom-made applicator. Later it was inserted into 20 early (2 to 3 months) pregnant cows, with 20 contemporary controls. Cows were monitored every 4 weeks until calving for signs of systemic infection and inflammation by collecting blood samples for haematology and measurement of acute phase proteins. Cows were also assessed for general demeanour, signs of discomfort and a vaginal exam using an endoscope was performed to confirm the presence and positioning of the device, and to ensure adequate vaginal drainage.

Results

Device retention was 85% until calving and there were no adverse effects from long-term device retention on cow health or pregnancy.

Conclusions

To our knowledge, this project describes the longest successful deployment of an intravaginal device in cattle with long-term retention and no adverse effects. The capacity of the device to carry a payload up to 11 cm long and 1.8 cm wide within its core module will make it a useful tool for incorporating various sensors for remote monitoring of various behavioural and physiological aspects.

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323 The P Challenge - raising awareness of the plasma inorganic phosphorus (PIP) test for managing your herd

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Introduction

A significant challenge for extension officers and advisors across northern Australia is to be able to confidently make a diagnosis for P requirements of beef cattle and provide advice in circumstances when responses to supplementation are likely to occur – especially in marginal situations. The Plasma Inorganic Phosphorus (PIP) test continues to be seen as the best indicator of the level of P in the diet of cattle.

The aim of the P Challenge was to: increase industry awareness of the value of PIP testing; to better understand the extent of the P deficiency in northern Australia, and; to develop a practical ‘in field’ system of sample collection.

Methods

An open call to participate in sampling cattle to determine their P status was extended to producers in Queensland, the Northern Territory and Western Australia. The criteria for entry into the project included: access to stock with adequate handling equipment; young breeders, heifers or steers on a good plane of nutrition; cattle grazing in a known P deficient region or old cropping paddock, and; reported growth rates in steers/heifers <120 kg pa., or poor reproductive performance.

Blood and faecal samples were collected from 20 animals per property, of the same class and from within the same mob. Blood samples were centrifuged at approximately 4000 RPM for 10 min, and serum was extracted and frozen. Faecal samples were pooled into a single specimen jar and frozen. Blood samples were analysed by Biosecurity Sciences Laboratory, Department of Agriculture and Fisheries Queensland.

Results & Conclusion

Samples from 15 mobs in the Pilbara and West Kimberley regions were collected. Seven herds (paddocks) were classified as adequate (1.95 to 2.68 Mmol/L), 4 marginal (1.38 to 1.5 Mmol/L) and 4 herds were deemed deficient (0.86 to 1.24 Mmol/L).

The results represent the average of the 20 animals sampled in the test. It is hoped that the price of the test may be able to be reduced if after collection of samples on site, equal aliquots of serum can be batched and tested as one sample, thus reducing costs of diagnosis. The correlation between the test average (n=20) and the batched samples was 0.99. It is still too early to determine whether batching samples on property will be a technique which will be available in the future. Initial indicators suggests that it has potential. There was large variation across results on some properties and this may be caused by individual animal variability in supplement intake, or differing grazing patterns.

Participating producers will receive feedback that will describe their results for the mob/paddock samples, and also interpretation of the likely causes and types of economic responses expected.

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367 Is mothering behaviour a potential measure of reproductive performance?

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Introduction

A dam's mothering behaviour post calving has had minimal research as a measure of reproductive performance. It is relatively easy to measure in the paddock and has been estimated to have a heritability of 0.2 to 0.3 (MLA project B.NBP.0759). However its value as an indicator of hard to measure reproductive performance traits is unknown. The aim of this paper was to investigate any association between mothering and weaning weight (WWT) and lactation anoestrous interval (LAI).

Methods

Mothering behaviour was scored in the paddock in the first 24 hours after calving using a scale of one to five. One indicated a dam that fled during recording through to five indicating a highly aggressive dam that was over protective of her calf. Mothering scores were recorded for 1,180 calving females located at Brian Pastures and Spyglass Research Facilities from 2014 to 2018, producing 2,154 mothering records as part of the MLA project B.NBP.0759. Breeds recorded were Brahman, Droughtmaster and Santa Gertrudis. Phenotypes pre-adjusted for fixed effects were extracted for WWT (n=1,999) and LAI (n=948) and mixed models run in SAS with contemporary group, breed and mother score fitted as fixed effects and tested for significance ($p < 0.05$). For 122 sires of cows with mothering scores, EBVs were correlated to see if the traits were associated. The mothering Estimated Breeding Values (EBV) were produced using a threshold animal model and BREEDPLAN EBVs for the sires were extracted for WWT (direct and maternal) and LAI.

Results and Discussion

There was no significant effect of mothering score on the pre-adjusted phenotypes for progeny WWT and LAI. Ideal mothering occurs midrange rather than the extremes and the highest frequency of data occurs in this range (Fig 1). There was a moderate correlation between mothering and LAI EBVs (-0.26), suggesting more aggressive mothers have a shorter LAI (Fig 2). Correlations were non-existent for both the direct (-0.01) and maternal (-0.05) WWT EBV. These results indicate that no strong relationships were detected. Therefore, the traits of interest need to be directly recorded rather than being indirectly selecting for via mothering score.

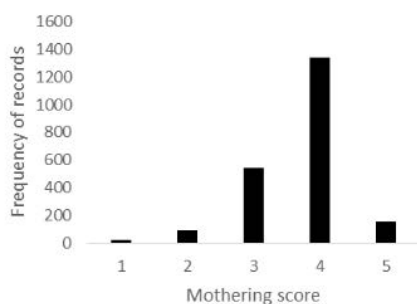


Fig. 1 Frequency of mothering scores. mothering

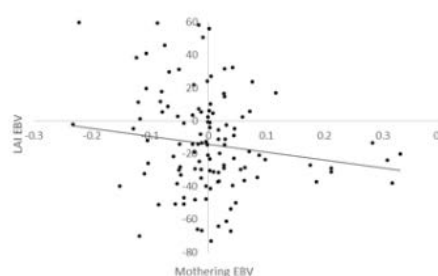


Fig. 2 Correlation between sire EBVs for and LAI EBVs.

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368 Implementing successful controlled mating programs in extensive beef herds

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Introduction

This study reviewed the recommended best management practice of controlled mating in northern Australian conditions. The aim was to better understand the issues associated with implementation and to therefore propose strategies to develop better guidelines for beef producers.

Method

A review of scientific papers, workshop and course materials, factsheets, news articles and published producer case studies was undertaken. Consultation with industry to determine issues with successful implementation, and to identify gaps in current implementation strategy guidelines, through a mock producer-based enquiry was then conducted. Two beef producer interviews were conducted to gain insights into the processes they used and issues they encountered.

Results

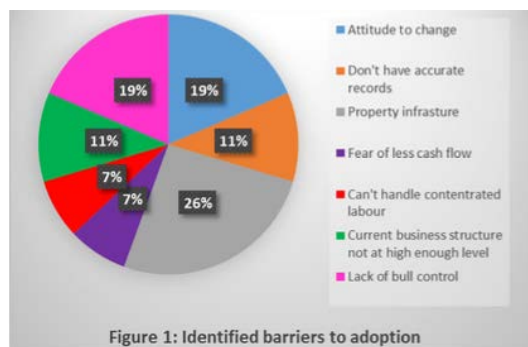


Figure 1: Identified barriers to adoption

Limited research was identified, with the majority relying on simulated model outputs using parameters from limited field experiments, particularly on a commercial scale, in northern Australia.

The information available to beef producers on the: potential benefits to productivity, relationships between time of calving and breeder body condition, and nutritional requirements is adequate. However, information on how to, at the enterprise level, successfully implement and the likely economic benefit from doing so was limited.

From the 10 industry surveys, 7 major barriers to adoption were identified (Fig 1). Respondents of the producer surveys identified lack of bull control, increased need for infrastructure, and attitude for change as the most challenging issues they faced when adopting the practice.

Discussion/Conclusion

Controlled mating, in order to prevent breeders lactating in the dry season, is a highly recommended best management practice across northern Australia. Property infrastructure, attitude to change and lack of bull control were identified as major barriers to adoption. The lack of evidence for economic benefits at a commercial scale also needs to be addressed. It is also difficult to develop a blanket strategy for the implementation of controlled mating, as every business is unique and therefore has different limitations and objectives.

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324 Validating the paddock to reef herd management practice framework with empirical data: a vaccination example

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Introduction

The Paddock to Reef Water Quality (P2RWQ) risk framework articulates farm management practices and relates them to the risk of soil erosion. Recent revision of the framework has incorporated a range of herd management practices, acknowledging that grazing properties operate in a holistic manner and as such, improving herd productivity can lead to improved sustainability with respect to grazing land management. A project is currently underway which assesses the data collected under the Grazing Management Practice Adoption (GMPA) surveys (Barbi *et al.* 2016) to validate and improve the management practices recommended under the framework.

This paper will present the methods behind validating the framework through an example of vaccination use.

Methods

Grazing property use of recommended practices, such as vaccinations, weaning management and breeder joining, is being scored against the P2RWQ herd management risk framework to ascertain a herd management score (low, medium and high risk). This score is statistically analysed against a number of key performance measures, such as weaning rate and live weight gain.

Results

Results from a vaccination example are shown in Table 1 below. These treatments are significantly different at the 95% confidence level ($P < 0.05$). A result like this confirms that practices recommended under the P2RWQ herd management framework are likely to improve productivity.

Table 1. Vaccination management practice score vs weaning rate

Vaccination management level	Weaning rate (%)
No vaccination	77.8
Partial vaccination	81.1
Best practice vaccination	88.5

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325 Documenting the spread of Indian (*Bothriochloa pertusa*) on Brian Pastures Research Facility

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Introduction

Indian couch (*Bothriochloa pertusa*) is a pasture species native to south-east Asia. Introduced as a pasture grass to Australia from the 1930's through to the 1980's, it has become naturalized through Queensland, and is spreading south through Queensland into the Wide Bay/Burnett region. Being tolerant of heavy grazing, *B. pertusa* rapidly invades bare ground, making it useful for managing poor land condition. These attributes also make it invasive, replacing desirable native species. Research to determine the production impact of *B. pertusa* invasion is ongoing (Spiegel 2016).

Brian Pastures Research Facility (BPRF), a 2000ha beef research property located 17km SE of Gayndah, Queensland, was a trial location for *B. pertusa* as a grazing pasture in the 1960's. Five *B. pertusa* strains were also trialed as lawn grasses on BPRF in the mid 1970's. *B. pertusa* has since expanded from the original plantings. This paper looks at the change in the presence of *B. pertusa* across the property from 1984 to 2018 using data from historical monitoring sites.

Methods

Thirty monitoring sites were established in remnant vegetation across different land types on BPRF in 1984. For each site, 10 quadrats were placed along a central 50m transect at 5m intervals, with pasture species present recorded. Eleven sites were surveyed in 1997. In 2016, 28 of the sites were re-located, and any missing transects were re-established using GPS as per the original methodology (Neldner Paton 1986). Transects were then surveyed in May 2018 to coincide with flowering to aid with species identification. *B. pertusa* presence at each site was then compared to previous years.

Results and

Table 1 sites sampled and proportion of sites with *B. pertusa*.

Year	Sites surveyed	Sites with <i>B. pertusa</i>
1984	30	0 (0%)
1997	11	2 (18%)
2018	28	9 (32%)

The number of sites sampled and the relative presence of *B. pertusa* is outlined in Table 1. *B. pertusa* presence has increased from 0% of sites in 1984 to 32% of sites in 2018. Only a select number of sites were surveyed in 1997, so the actual presence of *B. pertusa* at that time may be more than indicated by these figures. Most of the sites with *B. pertusa* present are small remnant vegetation stands left in cleared paddocks. *B. pertusa* has been observed along slashed tracks in paddocks with little or no other known *B. pertusa* presence. Sites located in un-cleared paddocks, and on hill-sides or ridges where grazing (and

clearing) is minimal were mostly clear of *B. pertusa*. In conjunction with other ongoing projects, this expansion of *B. pertusa* provides the opportunity to develop and trial potential treatments, and management guidelines under controlled conditions.

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326 Progress towards determining the feasibility of producing a sterile leucaena product

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Background and research vision

There is considerable interest from Western Australian (WA) pastoralists on the potential role of leucaena (*Leucaena leucocephala*) in northern WA. However, leucaena is a contentious species since although it is highly regarded for animal production, its status as an environmental weed precludes it from use on pastoral leases in the Kimberley and Pilbara regions of WA. Despite this, the potential area for dryland production of species of the genus *Leucaena* in WA is high and is a driver for considering the development of sterile/seedless forms. The key environmental constraints are likely to be the length of the dry season and low fertility of most soils other than the grey cracking clays (vertosols). Psyllid resistance and cool temperature tolerance are likely to be of secondary importance.

Opportunities for irrigated production are also emerging and may allow leucaena species to be used in environments previously considered well outside their home-range. It is desirable now to re-examine the diversity of the wider *Leucaena* genus for adaptation to WA conditions generally and for the purpose of selecting elite parent material for use in a sterile/seedless leucaena breeding program. These perennial species that can be under production for 30 to 40 years need to be evaluated in the target environments for at least 3-5 years to fully understand their potential as adult plants.

Strategies to breed sterile leucaena for WA include plant breeding and biotechnology tools to generate sterile lines at both the tetraploid and triploid ploidy levels. For tetraploids, the main target species is the commercial *L. leucocephala* that is well known for its potential as a high quality, productive and persistent forage. Gene editing technologies (CRISPR) will be utilized to edit out flowering genes and develop a non-flowering *L. leucocephala*.

For triploids, the strategy is to cross tetraploid species (*L. leucocephala* and/or *L. diversifolia*) with diploid species to generate sterile triploid hybrids. The diploid parents will include species that have good forage attributes such as *L. collinsii*, *L. macrophylla*, *L. shannonii* and *L. pulverulenta*. Several of these triploid crosses have already been created by the Department of Primary Industries and Regional Development (Perth, Western Australia) and will be evaluated in the Kimberley and Pilbara regions of Western Australia for their agronomic performance and sterility. Vegetative propagation will be required for the tetraploid gene-edited non-flowering *L. leucocephala*. Triploids can either be vegetatively propagated, once generated, or generated via a seed production nursery.

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327 Does ground cover influence profit? Sky-high technology or sky-high thinking?

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Introduction

A project investigating the relationship between ground cover, enterprise profitability and animal productivity is on-going in the Fitzroy and Burdekin catchments of the Great Barrier Reef Lagoon. Following a review of current literature, the information gaps identified have informed the prioritisation of subsequent work for this project. Work objectives now aim to quantify relationships between ground cover and animal productivity to inform bio-economic modelling and to examine the implications to the business of adopting improved management practices.

Methods

The approach in use to investigate the biophysical responses involves the analysis of existing data from research trials uncovered in the literature review and modelling with GRASP (McKeon *et al.* 2000). Stock live weight gain (LWG) data, remote sensed and visual ground cover recordings over time from Wambiana Grazing Trial, Spyglass Research Station and the Brigalow Catchment Study have been sourced. Response functions derived from this analysis will be used in a desktop modelling component of the project. Commercial properties greater than 2000 ha in the catchments have been mapped and identified for their ground cover trend over an 18 year period. The learnings from case studies on 6 of those properties in the top 20th percentile for improving ground cover will inform the costs and time-frames around the changes that contributed to the increase in cover level over time, these costs applied in the desktop modelling.

Interim findings

Average daily gains against ground cover over time on the Wambiana Grazing Trial are not correlated ($R^2 = 0.0007$). However, there is an apparent difference in the variance of LWG at different cover levels. At less than or equal to 50% ground cover there is 38.1% more variance in average daily gains than at greater than 50% ground cover level. This would suggest that although improved animal productivity is not expected at lower ground cover levels, there is a benefit of reduced risk while retaining higher minimum cover. One case study on a property S-W of Charters Towers has highlighted interesting patterns concerning this risk/return relationship.

An updated bio-economic model is in development that takes LWG data from GRASP and makes adjustments depending on stock class, age and weight. Other improvements include: land type specific growth paths, dynamic leads/tails and marketing options. This will help to overcome some of the previous limitations of integrating GRASP output into bio-economic models previously identified in modelling exercises (Jones *et al.* 2016).

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328 Modelling the current and potential spread of exotic grass *Bothriochloa pertusa* throughout sub-coastal

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The invasive exotic grass species *Bothriochloa pertusa* was first introduced in the 1930's into eastern Queensland to be trailed as a pasture and lawn grass species. Since its introduction *B. pertusa* has naturalised and is thought to have spread widely throughout Queensland. Current estimates of its spread are undetermined; however, its presence is widespread, spanning from south-west of Mackay to north of Charter Towers. The species is thought to be moderately beneficial as a pasture grass in low fertility soils, however its inherently low biomass and drought tolerance reduces its production value and in areas where it outcompetes more desirable pasture species has been associated with significant production declines. Using information on the current and historical distribution of *B. pertusa* we aim to map and analyse its spread throughout the Burdekin region of Queensland and investigate trends in *B. pertusa* density across ranges of environmental, climate and soil predictors. Finally, using this data alongside phenological attributes of the species we aim to formulate habitat and climate suitability models to predict areas vulnerable to future invasion. This research will be integral for managing the species current and future spread and to minimise further negative production and environmental impacts.

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329 A case for focusing on production systems over management practices to improve adoption rates

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Introduction

Historically, management practices are largely researched and extended in a somewhat derivative manner. While this is understandable given the need to understand cause and effect in a research world, it often results in very broad messages available for extension practitioners to use whilst recognising the complexity in the biophysical systems in which graziers operate. For example, some of the broad key messages in the grazing land management (GLM) space are matching stocking rate to carrying capacity and wet season spelling. Meanwhile, adoption of these practices has remained largely unchanged over the last 7 years (Australian & Queensland Governments, 2016).

This paper provides insight into why this might be the case by conducting an economic analysis of a property for 2 different production systems implementing the same management practice on the same land-type. In this case, the property has introduced wet season spelling into their production system as part of the project and has been successful in greatly improving pasture yield and land condition in the affected paddock.

Methods

A whole farm economic analysis was conducted on the property, over a 20-year period, which compared the effects on profitability of introducing the management system change of wet season pasture spelling on a production system turning-off weaners (the current system) or one turning off slaughter steers. ADOPT (Kuehne, *et al.*, 2013) scenarios were used which analysed the peak adoption for both scenarios.

Results

The results (Table 1) show that wet season spelling increased profitability for systems turning-off slaughter steers but not those turning-off weaners, the latter being unprofitable. In addition, there was an increase in peak adoption for the former system of 32% compared with only 11% for the latter production system.

Table 1. Effects of wet season spelling on profitability and adoption of practice

	Net present value (\$)	Internal rate of return (%)	Peak adoption (%)
Slaughter steers	59,811	6.6	32
Weaners	-63,602	-5.6	11

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330 Long term effects of different stocking strategies on sustainability and profitability in a variable climate

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Introduction and methods

Rainfall variability is a major challenge to sustainable and profitable grazing. We tested the ability of five grazing strategies to cope with rainfall variability over 21 years at 'Wambiana' near Charters Towers, Qld (O'Reagain and Bushell 2011; O'Reagain *et al.* 2018). The site is in the *Aristida-Bothriochloa* community on tertiary sediments. Strategies were heavy stocking at 4 ha/animal equivalent (AE), moderate stocking at long term carrying capacity (LTCC: estimated at 8 ha/AE), moderate stocking with spelling, flexible stocking and flexible stocking with spelling. Data is presented averaged over the spelled/unspelled variants for both the moderate and flexible stocking strategies (Table 1). Rainfall was variable (246-1223 mm) over the trial period. Strategies were managed adaptively as conditions changed to emulate what a 'real grazer' would do in similar circumstances.

Results and discussion

Results showed that moderate stocking at LTCC, both with or without spelling, maximised individual animal production and carcass value (Table 1). Total liveweight gain (LWG) per hectare was higher under heavy stocking, but this required drought feeding with full or partial destocking in six of the 21 years. Average gross margins under heavy stocking (\$5/ha/yr) were less than half those under moderate stocking (\$12/ha/yr). The density of perennial, palatable and productive (3P) grasses declined markedly under heavy stocking, significantly reducing carrying capacity and drought resilience.

Table 1. Average liveweight gain (LWG) per head (hd), LWG per hectare (ha), gross margin (GM/ha/yr) and years of drought feeding over 21 years and 3P grass density for 2017.

Stocking strategy	LWG/hd (kg/hd)	LWG/ha (kg/ha)	GM/ha (\$/ha/yr)	Drought feeding (yr)	3-P density (plants/m ²)
Heavy	98	20	5	6	1
Moderate (\pm spelling)	116	15	12	1	5
Flexible (\pm spelling)	113	16	13	1	4

Flexible stocking (\pm spelling), was no more profitable than fixed moderate stocking. 3P density was also slightly poorer relative to fixed moderate stocking due to a delay in cutting stocking rates prior to the 2002-2007 drought. The advantages of more risk-averse flexible stocking were convincingly shown in the 2013-2017 drought with both (spelled and unspelled) fixed moderate stocking strategies overgrazed and requiring destocking in the 2017/18 wet season. This suggests that in the longer term, flexible stocking (with spelling) will be the most profitable and sustainable management strategy.

These results clearly show that heavy stocking rates are neither sustainable nor profitable. It is possible to be sustainable and profitable in a variable climate through the application of risk averse, flexible stocking around long term carrying capacity.

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33 | Animal performance from psyllid resistance leucaena (Redlands)

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Background

A multiyear replicated animal trial has been established at Pinnarendi Station. Leucaena establishment and design has been described (Lemin et al., 2018). This trial will compare liveweight gains (LWG) of cattle grazing the psyllid resistant variety Redlands, with the commercial cultivar Wondergraze in a psyllid-prone environment.

Materials and Methods

The 61 ha site at Pinnarendi Station (18.03849 S, 144.872453 E; 759 m ASL) has yellow to red-brown granite-derived soil (pH ~6.4) and 690 mm average annual rainfall falling Nov- Apr. Eight plots (4 x Redlands and 4 x Wondergraze), at ~7 ha each of leucaena (10 m row spacing), contain inter-row pasture of *B. pertusa*, *C. rotundifolia*, *U. mosambicensis* and *Stylosanthes* spp. In June 2018, 16 Droughtmaster steers and 12 Brahman X steers were allocated to either Redlands or Wondergraze paddocks in one of 4 groups with 7 animals/group blocked according to breed (4 x Droughtmaster and 3 x Brahman X) and LW. Cattle rotated through paddocks according to treatment (2 groups per treatment). All cattle were fed molasses ((weekly or fortnightly); equiv. 1 MJ ME/hd/d) to habituate handling. The trial was approved by DAF Animal Ethics Committee (SA 2017/12/628).

Results

All cattle were weighed at regular intervals from June 2018 to Mar2019, a period of 250 d. Weigh dates included 07.8.2018, 20.9.2018, 08.11.2018, 19.12.2018 and 05.03.2019. For all trial cattle, the minimum dry season average daily liveweight gain (ADG) was 0.15 kg and the maximum wet season ADG was 1.51 kg. Psyllid damage to the Wondergraze leucaena was not apparent during the trial period. The ADG was determined for Redlands and Wondergraze treatments (Table 1).

Table 1. Comparison of average daily gain (ADG) data over 250 days (mean ± s.e.)

	Grazing period	ADG (kg) 250d
Redlands	28.6.2018 – 05.03.2019	0.698
Wondergraze	28.6.2018 – 05.03.2019	0.690
Pooled s.e.		0.019

Discussion and Conclusions

The cattle readily consumed Redlands, and ADG was comparable with the commercial variety Wondergraze. Weight gain on both Redlands and Wondergraze was positive across all weighing intervals which could not be achieved on unimproved northern pastures. In March 2019 additional trial cattle were introduced to an adjacent paddock with fertilised improved pastures only. The ADG data will be compared and benchmarked to regional performance over the next three years.

Acknowledgments

This project is jointly funded by DAF and Meat and Livestock Australia (MLA).

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332 Preliminary animal performance for cattle grazing leucaena in timbered northern basalt country

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Introduction

Fertile, free-draining basalt soils in northern Qld are suited to leucaena production. Low adoption of leucaena on these soils is partly attributed to lack of existing cleared sites. Whitewater Station (18.1467 S, 144.3183 E; 600-700 m ASL) includes a mix of red basalt (60%), granite (35%) and black basalt (5%) soils. Average annual long-term rainfall is 796 mm (70% falling Dec-Mar). Whitewater supplies BrahmanX and Droughtmaster cattle to live export and local store markets. Stocking rates are 1 Adult Equivalent (AE = 450 kg dry animal at maintenance) to seven hectares. The 33 ha leucaena (10 m rows, v. Wondergraze) site is lightly timbered and dominated by naturalised pastures of Indian couch (*B. pertusa*) with some native pasture species. This paper describes performance of cattle grazing leucaena with cattle grazing pasture only in a neighbouring paddock.

Materials and Methods

In July 2018, 18 weaner steers [~ 231 kg liveweight (LW)] were introduced to naturalised and native pastures in a neighbouring paddock for comparison to leucaena grazed steers (~228 kg LW). Stocking rates were identical. Cattle in both paddocks had access to a dry season weaner supplement (Jul 2018 to Sept 2018). Cattle grazing leucaena continued to have access to supplementation until Dec 2018. Cattle grazing pastures were fed M8U from Sept 2018 to Dec 2018 to reach market specifications. Supplementation for both groups of cattle ceased in Dec 2018 with the onset of the wet season. Cattle LW and supplement intakes were measured periodically

Results

Average daily weight gains of steers were positive for steers grazing leucaena versus pasture only in two of three measurements (Table 1.). Liveweight at the end was 337.5 kg and 318 kg, respectively.

Table 1. Comparison of average daily gains (ADG) and summary of weaner supplement (WS) and molasses (M8U) costs in weaner steers grazing leucaena + pasture or pasture only at Whitewater Station.

Grazing Periods	Leucaena		Pasture	
	ADG (kg)	Supplement (cost/head/day)	ADG (kg)	Supplement (cost/head/day)
63 days (20 Jul – 21 Sept)	0.47	WS (\$0.36)	0.06	WS (\$0.61)
87 Days (21 Sept – 17 Dec)	0.27	WS (\$0.66)	0.34	M8U (\$0.47)
74 days (17 Dec to 1 Mar)	0.75	\$0	0.69	\$0

Discussion and Conclusions

Leucaena can be established in lightly timbered fertile basalt country. Animal performance was mixed, due to management and supplementary feeding. The stocking rate on the leucaena was based on removal of cattle in December and supply of leucaena leaf was limited with continued grazing into March 2019. Further work is required to determine the long-term productivity and economics of leucaena across the basalt soils of northern Queensland. Stocking rates will be adjusted and full-year steer liveweight performance will be recorded in the leucaena paddock from July 2019.

Acknowledgements

The Whitewater Producer Demonstration Site was jointly funded by DAF and MLA. ^A Corresponding author:

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333 Navua sedge control on the southern Atherton Tablelands, Queensland

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Background

Navua sedge (*Cyperus aromaticus*) is an aggressive tropical weed introduced to Australia from central Africa via the Pacific Islands in the 1990s. The weed is restricted to tropical high-rainfall areas, forming dense stands that smother productive pastures (Vitelli *et al.* 2010). Heavy infestations severely affect pasture productivity and consequently the viability of grazing enterprises in the Atherton Tablelands region. Effective control options are limited and expensive. Good grazing management reduces the chance of sedge establishment. In 2016, the Malanda Beef Plan Group and Queensland Department of Agriculture and Fisheries established a 3 year project to investigate control methods for Navua sedge in Atherton Tablelands pastures.

Project outline and results

Two beef grazing properties in Jaggan (red loam) and Millaa Millaa (red-brown clay soil) on the southern Atherton Tablelands, evaluated various rates and proportions of herbicides, Sempra and Banjo to control Navua sedge. Herbicide mixtures were applied during 2 growing seasons (2016/2017, 2017/2018) on undulating, highly-productive improved pastures, predominantly Nandi setaria and Brachiaria. Repeated visual assessments in 2017 and 2018 (see Table 1) using a 0.5m² quadrat marked on a grid and handheld GPS unit, estimated the proportion of pasture to weed (%) over a total of 102 GPS points. Herbicide mixes were applied with a boom-less spray unit in double overlap spray technique (total volume herbicide mixture, 200–250 L/ha) in October/November of each year. After 3 applications of Sempra and Banjo some reduction in quality was observed (smaller seed heads and spindly, yellowed stems) but well established sedge plants continued to survive. Additional ad hoc small plots treated with either lime, slashing or urea yielded no difference in weed prevalence.

Navua sedge	Frequency (%)		Yield (%)	
	Jaggan	Millaa Millaa	Jaggan	Millaa Millaa
2017 October	16.4	46.0	2.3	7.4
2018 October	10.0	18.0	0.5	0.6

Table 1. Change in frequency and yield of Navua sedge on 2 trial sites (Jaggan and Millaa Millaa).

Future direction

Current control strategies for Navua sedge have limited efficacy and, at \$100/ha.treatment, represent significant cost to a beef/dairy grazing business. However, few alternatives are available. In the next 12 months, the project will examine the use of fire before chemical treatment in heavily infested pastures, and continue research into a biological control agent and “Smart-Boom” technology. Smart-Boom technology selectively targets Navua sedge plants for more efficient and cost-effective spray usage. The project team will continue to inform producers on control strategies, and promote landholder diligence on hygiene, weed identification and pasture management.

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334 Producer feedback on the production value of Indian couch in central QLD

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Introduction

The introduced, stoloniferous Indian couch grass (*Bothriochloa pertusa*) has spread across large areas of central and northeast Queensland (Jones 1997). Further expansion has occurred in Queensland (Spiegel *et al.* 2016). Mixed views on the value of Indian couch as a pasture grass exist. Some graziers are favourably disposed, but others are concerned about production losses, particularly during droughts (Jones 1997). This paper presents feedback from Banana Shire (central Queensland) on Indian couch presence on property and the impacts on carrying capacity.

Methods

In March 2017, the Dept of Agriculture and Fisheries delivered Indian couch and pasture dieback community forums in Biloela and Moura. A short questionnaire on Indian couch was provided to producers. Results have been presented as percentage distributions (%) for Indian couch presence on property (including yes/no, what proportion, any changes, and affected land) and impacts (if any) on carrying capacity (CC).

Results

Forty-two questionnaires were collected for Biloela and 29 for Moura. Responses showed most producers (96%) have Indian couch, where the proportion of their property affected is typically $\leq 25\%$. The area affected has increased over time according to 81% of producers in Biloela and 52% in Moura. Many producers (76% in total) indicated that the land affected is cleared country. Indian couch is having an impact on CC according to 64% of producers in Biloela and 38% in Moura. This impact is a decrease in CC as indicated by 42% of producers, or otherwise no details provided (i.e. blank response). The order of magnitude of CC losses is anything from 20% decrease to as high as an 80% reduction. There was no indication of an increase in CC, and for those producers who indicated no impact on CC, it was either because of a blank response or a response of 'Not yet' or 'As yet only very small areas' affected.

Discussion and conclusions

Producer feedback provides important anecdotal evidence. For producers in the Banana Shire of central QLD, feedback has indicated that further spread of Indian couch on property could have detrimental impacts on beef businesses through a reduction in carrying capacity. Future research on Indian couch will need to quantify the production impacts and long-term carrying capacity with Indian couch, and assess implications of this for cattle production and pasture management.

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335 Managing native pastures in the Burdekin with NDVI handheld sensors

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Introduction

Forage budgeting is widely promoted as a tool in pasture management to help graziers match stocking rates with forage supply. It requires an estimate of pasture yield, typically determined visually from photo standards. These subjective visual estimates can however be subject to operator bias (Spiegel *et al.* 2015). The use of handheld NDVI (Normalised Differential Vegetation Index) sensors is an alternative objective method that has shown promise for forage budgeting within Mitchell grass pastures (Phelps *et al.* 2015). This paper examines the suitability of this NDVI technology for forage budgeting within heterogeneous pastures in the Burdekin.

Methods

Calibration cuts from quadrats along fixed transects were assessed over a 12-month period (2018/19) on 2 properties in the Burdekin of different pasture types and landtypes: buffel grass (*Cenchrus ciliaris*) and Indian couch (*Bothriochloa pertusa*) on granodiorite, and black speargrass (*Heteropogon contortus*) and Indian couch on red basalt. Calibration quadrats were assessed for ground cover (%), pasture height (cm), green visual (%) and a mean NDVI reading taken using a Trimble GreenSeeker^R. Calibration quadrats were then cut, a subsample taken for green-dead sorting, and dried for biomass calculation and analysed for crude protein content. Correlations were calculated to indicate the strength of association between the NDVI values and the pasture measures.

Results

Table 1 shows the values from the GreenSeeker^R NDVI handheld sensor were highly associated with pasture greenness measures and crude protein (%), but not with total biomass.

Variable	Mean NDVI
Green visual (%)	0.94
Green DM (%)	0.91
Green biomass (kg DM/ha)	0.79
Crude protein (%)	0.70
Total biomass (kg DM/ha)	0.10

Table 1. Correlations of various pasture with mean NDVI.

Discussion and conclusions

The GreenSeeker^R provides a good proxy for quick and accurate assessments of pasture quality, with the validity of this technology for forage budgeting based on the highly palatable component of pasture on offer, i.e. green biomass rather than total biomass. The application of this technology for producers as a tool for managing the diverse pastures in the Burdekin is still under investigation.

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336 Quantifying the production impacts of Indian couch in pastures

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Introduction

Preliminary research on Indian couch has shown minimal impacts of this introduced stoloniferous grass on steer weight gains (Jones 1997). However, this is at variance with producer experiences and the continuing expansion of Indian couch across eastern Queensland is of concern to the grazing industry. The Department of Agriculture and Fisheries along with Meat & Livestock Australia have jointly funded a project (Project No. B.ERM.1105) to assess the extent of Indian couch invasion, production impacts and management options. This paper outlines the scientific approach adopted in this project to quantify the production impacts of Indian couch.

Scientific approach

The SWIFTSYND methodology (Day and Philp 1997) is being used to measure the production of Indian couch invaded pastures relative to intact native pastures. Five native grass and Indian couch 'paired' sites have been established in the upper Burdekin (red kandosol and red basalt) and north-Burnett (brown basalt, black basalt and gradational loam). These sites cover a range in climate, soil texture, soil depth and Indian couch strains – factors which may each impact on pasture growth.

The methodology involves the use of selected pasture 'exclosures' (~30 m x 30 m). Pasture grown in the prior season is first removed. Pasture biomass is then measured at intervals throughout the subsequent season, providing a measure of pasture growth during the growing season, and pasture detachment during the dry/winter season. Previously harvested areas are also re-harvested to assess impacts of prior defoliation, thus accounting for any differences in the growth phases and grazing tolerance of grasses. The method also includes the assessment of pasture cover (green, dead and bare), soil moisture, grass basal area and pasture components (i.e. dominant species; leaf, stem and inflorescence components; live and dead components). These field measurements have been specified under the SWIFTSYND methodology to allow calibration of the GRASP (GRASs Production) model.

Outcomes

SWIFTSYND field data will allow direct comparison between Indian couch and native pasture growth and detachment. Once calibrated, GRASP will be used to simulate pasture production based on historical rainfall and climate data, thus allowing an assessment of pasture production impacts of Indian couch invasion over a wider range of seasons than will be encountered during the period of field measurements (2 seasons under the current project). Ultimately, the field measurements and model results will provide the basis for an objective assessment of the impact of Indian couch invasion on long-term carrying capacity on these sites, and a means of extrapolating these findings across the region of Indian couch invasion.

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337 Can fire be used to manage feathertop wiregrass in Mitchell grass pastures?

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Introduction

Feathertop wiregrass (*Aristida latifolia*) is relatively unpalatable and builds up during runs of good seasons. It has high seed production and can become dominant in overgrazed pastures. Feathertop wiregrass competes well once established and is hard to control using grazing management alone.

Fire has been shown to control feathertop wiregrass in western Queensland. However, success appears to be highly dependent on timing – low soil moisture is needed for several weeks before and after burning. This means that in many parts of northern Australia, the prime time for success coincides with the highest risk of wildfire. However, producers are wary of burning their best pasture resource in the middle of the dry season to control feathertop wiregrass

We collaborated with Consolidated Pastoral Company (CPC) and Barkly Landcare & Conservation Association to determine whether the rewards of burning at critical times would justify the risks in the Barkly region of the NT.

Methods

A site was selected on Newcastle Waters Station that contained a moderate level of feathertop wiregrass together with stands of desirable grasses including curly bluegrass (*Dichanthium fecundum*) and weeping Mitchell grass (*Astrebla elymoides*). We used a randomised block design comprising four replicates of three treatments (Unburnt controls, July 2017 burn and September 2017 burn). Pastures were assessed using the Botanal method. Plant size and seed production measures were also collected from 290 permanently tagged individual tussocks from the grass species indicated. Soil moisture at the surface and at 15 cm depth was measured before burning. The site was completely spelled from grazing for the duration of the experiment. We attempted to repeat the experiment in 2018, but fuel continuity was insufficient to carry any fires following below-average wet season pasture growth.

Results

When we returned after the wet season in April 2018 we found that:

- Burning reduced the basal area and biomass of feathertop wiregrass
- The fires had only killed 1% of the feathertop wiregrass plants
- Burnt plots had lower pasture yields and ground cover overall
- Burnt plots had more “weedy” annuals like sensitive plant (*Neptunia* spp.)
- No desirable perennial grasses were killed
- Burning increased seed production in curly bluegrass

Conclusion

- Even under the right soil moisture conditions, it’s not a certainty that you will get a good kill of feathertop wiregrass - some years it will work, some years it won’t
- High fuel loads (>2,000kg/ha) and high fuel continuity are needed to get a clean burn
- Producers can now make informed risk-based decisions to control feathertop wiregrass using fire in the Barkly region.

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338 Better landscape utilisation without more fences - can it be done?

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Introduction

Self Herding is a behaviour-based livestock management approach, which provides strategies and tools to positively influence grazing behaviour. Meat and Livestock Australia is currently supporting the first-ever trial of Rangelands Self Herding in the Northern Territory at Victoria River District Research Station (also known as Kidman Springs).

The trial aims to demonstrate that Self Herding techniques can be used to establish grazing circuits within a paddock, creating a form of rotational grazing that does not rely on expensive and fixed fencing. We selected a paddock that has large contrasts in land condition created by historical grazing patterns. By applying Self Herding techniques, specifically the use of sight, sound and smell signals linked to feed rewards, we aim to encourage cattle to use areas that have previously been under-utilised whilst reducing the usage of areas that have poorer land condition.

The project is a collaborative effort between Revell Science, Stress Free Stockmanship, NT Department of Primary Industry and Resources, Territory NRM, Rangelands NRM (WA) and Oxley Grazing.

Methods

We are using small amounts of feed attractants paired with signals to encourage cattle to make choices in response to positive behavioural and/or nutritional feedback. We use a mobile “attractant station” to achieve managed movements of cattle throughout the landscape. Many producers already move lick around their paddocks, but this method amplifies that approach by offering a variety of attractants using intermittent and unpredictable timing. This has the effect of increasing interest for a broader range of animals in a mob and rewards exploratory behaviours which then influence the dietary experimentation that the animals exhibit.

GPS tracking collars have been fitted to 10 heifers in the trial and these fix a location at hourly intervals. We use the GPS location data to create weekly “heat maps” of how cattle are using the paddock in relation to the attractant station and environmental factors (such as rainfall and fire).

At the conclusion of the trial we will be reporting on: paddock and pasture utilisation patterns, labour and vehicle costs, management experiences with the techniques and the cost of consumables (e.g. the feed rewards). We will also conduct a longer-term economic comparison of using Self Herding versus fencing or virtual fencing to improve paddock utilisation patterns.

Results

In the first weeks of the trial the cattle demonstrated a very strong attraction to the historically overgrazed areas of the paddock. The project team then implemented a range of Self Herding techniques to attract the cattle away from the overgrazed areas and into other areas of the landscape that were being under-utilised. The GPS data clearly indicate that the techniques have influenced the grazing areas of interest for cattle in the paddock.

More information about the trial and the results can be found at <https://futurebeef.com.au/projects/self-herding-kidman-springs/>

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339 A pen-side test for the rapid diagnosis of bovine respiratory disease

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Introduction

Infectious diseases are responsible for major health problems within the Australian beef industry. Bovine respiratory disease (BRD) is an infectious disease complex that has a considerable impact on the Australian feedlot industry. It is responsible for more than 70% of all illness, 50% of deaths and costs this sector of the beef industry approximately \$100 million annually. The implementation of field-based diagnostic assays as part of a BRD control program has the potential to increase productivity in feedlots. Loop mediated isothermal amplification (LAMP) is a novel molecular technique that rapidly amplifies nucleic acids under isothermal conditions within an hour. There is no requirement for sophisticated equipment. Modification of this assay can allow for the detection of LAMP products on a simple lateral flow device (LFD), allowing the whole process to be conducted in the field.

Methods

LAMP assays were designed to detect bovine viral diarrhoea virus 1 (BVDV1), bovine herpesvirus 1 (BHV1), *Mycoplasma bovis* (*M. bovis*) and bovine coronavirus (BCoV). To facilitate detection on an LFD, the assays were modified via the conjugation of forward and reverse primers to biotin and FAM or digoxigenine (DIG) respectively. For positive LAMP reactions, both tags are incorporated into the amplicon resulting in a visible test line in addition to a flow-check control line.

For use in the field, different methods of sample preparation were assessed (and compared to commercial kits) to make the whole process as simple as possible without compromising sensitivity.

Results

BVDV1, BHV1, *M.bovis* and BCoV were all successfully detected using LAMP in conjunction with LFDs. The sensitivities of these LAMP assays were comparable to real-time polymerase chain reaction (PCR) assays currently used for the detection of these pathogens in the laboratory. Pathogens were able to be detected with minimal preparation of samples.

Discussion/Conclusion

The ability to rapidly identify pathogens at point-of-care (up to two hours by LAMP-LFD verses 24 to 72 hours via clinical laboratory diagnosis) enables producers and veterinarians to more effectively manage BRD. This equates to a reduction in herd exposure to pathogens, reduced treatment costs and more targeted treatment which can reduce morbidity and mortality and ultimately leads to improved production.

There is potential for this technology to be utilised for other diagnostic scenarios encompassing veterinary health within the beef industry, such as reduced reproductive performance associated with BVDV.

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340 Improving the Leucaena Code of Practice to kill wild, ungrazed leucaena.

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Abstract

Leucaena-based pasture offer one of the most productive feed-base options for northern beef producers where rainfall and soils are suitable. This project aimed to provide beef producers, land managers and councils with additional chemical options to meet the increasing integration of Leucaena into pasture management and to control unwanted wild and ungrazed infestations to support the leucaena industry Code of Practice. The work facilitated a number of trials to identify effective control options to seek a APVMA minor use chemical permit to control unwanted wild leucaena that exist in many Queensland shires. This work was supported and was in collaboration with MLA, AgForce Queensland, Dow AgroScience, Department of Agriculture and Fisheries and The Leucaena Network. Nufarm kindly supported the trials by donating some of the herbicides.

Replicated trials were conducted at Brian Pastures Research Station Gayndah on 9-10th of December 2015 and Belmont Research Station, Rockhampton on 12-13th January 2016. Trials were conducted on large, mature leucaena plants 2 metres to 4 metres in height. Eighteen herbicide treatments were applied across a range of application methods - basal bark, cut stump, gas gun (low-volume, high-concentration), stem blaze and ground applications of granular residual herbicides.

The registered basal bark and thin line product gave consistent, high mortality results while other options offered potential control options.

Results:

Good results	Poor Results
Access – basal bark & thinline	Metsulfuron - cut stump - signs of regrowth
Stinger – cut stump	Glyphosate cut-stump – signs of regrowth
Tordon granules	Gas gun not useful for plants > 2m tall
Vigilant II – cut stump (labour intensive)	Graslan and Velpar – low mortality. Pasture impact

341 Effect of various renovation techniques on rejuvenation of leucaena systems

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Introduction

Brian Pastures Research Facility, Central Burnett, has stands of leucaena dating back to 1975. Research has found live weight gains in steers grazing a leucaena/grass pasture system can be increased by up to 115kg/head/year in comparison with Black Speargrass pasture (Quirk et al. 1990), indicating this is a resource worth maintaining. Sporadic grazing combined with narrow row spacing has resulted in overgrown plants, undesirable seed set and low pasture yields. Renovations were conducted between 2011-2015 to widen row spacing, remove volunteer plants, and improve pasture growth and access. 13 blocks were renovated in total using one of four techniques (Fig. 1).

Methods

Nine representative blocks were monitored at the end of the 2017 and 2018 wet seasons to identify significant differences in inter row rejuvenation as a result of the renovation technique applied. Twenty random quadrats in the inter rows were measured for number of inter row rogue seedlings, inter row rogue seedling height, % ground cover, and % green. Pasture yield and species composition was recorded as an average for the entire block. Data was statistically analysed using ANOVA for a complete randomised design. It should be noted that there is no un-renovated control treatment in the design and this comparison only addresses variations between techniques post renovation.

Results and Discussion

There was no significant difference in pasture yield, % green, % ground cover or number of inter row rogue seedlings, indicating that inter row rejuvenation did not vary depending on the different technique applied. However there was a significant difference ($P=0.04$) in height of inter row seedlings with a greater height for technique 2 compared with techniques 3 and 4 (Fig. 1). It was observed that technique 2 had greater amounts of exposed roots in the inter row post renovation, presenting the opportunity for rogue leucaena growth from an established root systems as opposed to slower establishment from seed. Further investigation is needed into the potential impact of rate of inter row rogue leucaena establishment on pasture yield and composition.

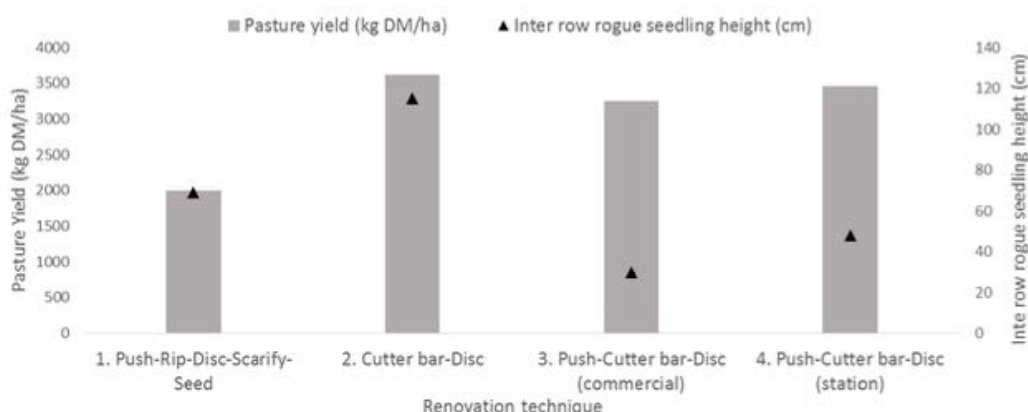


Fig. 1 Effect of four renovation techniques on pasture yield and inter row seedling height.

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342 Redlands for regions – improving in-paddock nutrition across northern Australia

Bron Christensen

The Leucaena Network

Introduction

In November 2017 The Leucaena Network, in partnership with the Queensland Department of Agriculture and Fisheries (QDAF), commenced a 17-month leucaena establishment project with six progressive graziers in psyllid prone areas within coastal and north Queensland. This project was funded by Meat and Livestock Australia donor company (MDC) and aimed to demonstrate best management practices for the successful establishment of the new psyllid resistant leucaena variety 'Redlands'.

Methodology

Six graziers, located in psyllid prone areas from Mackay to Cairns in coastal tropical Queensland, planted up to 40ha of Redlands leucaena. Site selection, and best management planting and establishment practice advice and support was provided where possible by QDAF extension officers located at Mareeba, Mackay and Rockhampton. Outcomes were monitored throughout the establishment phase, peer-to-peer support was encouraged through on-site visits to all trial sites, and grazer meetings to discuss progress and share information and experiences occurred. Capacity building was provided to the project participants with attendance at a Leucaena establishment and management workshop which provided a comprehensive overview of leucaena establishment, and participation in the MLA's Business EDGE workshop.

Discussion

Despite the best efforts of all participants and collaborators, only three producers achieved successful establishment of Redlands leucaena within the 17-month time frame of the project. At some sites the specific timelines of the project hindered site planning and timeliness of operations. Leucaena was unable to be established despite replanting at one site due to soil constraints coupled with unprecedented heatwaves and dry conditions, followed by torrential rain and flooding. All producers experienced establishment issues unique to their own property, from extensive existing pasture and legume coverage creating cultivation and site preparation problems; incorrect planting depth for individual soil types; erosion and seedling waterlogging from heavy rain; and unseasonal weather patterns. Of the sites that were established, one was able to undertake a light graze six months after sowing, followed by heavier grazing soon after due to quick regrowth and high feed availability. In mid 2019, the liveweight gain of steers grazing leucaena will be compared to steers grazing adjacent grass-legume paddocks, both over a 12 month period at this site. The second trial site will be grazed in April 2019, fourteen months after planting. It's anticipated a first graze within the expected 18 month establishment time frame will occur at the third trial site.

Where successful establishment occurred, a key component was the availability of on-site assistance provided by either a DAF extension officer or the grazer's own agronomist. The timely availability of one-on-one support from experienced personnel was a critical success factor. This project has confirmed the importance of graziers following the best management guidelines and obtaining qualified peer and agronomic support, to obtain successful establishment in areas where leucaena has not been sown before.

343 Objective, robust, real-time animal welfare measures for the Australian red meat industry: Phase I validation

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Introduction

Consumers base their consumption decisions on a range of factors with a significant emphasis on animal welfare issues. When animal welfare is compromised, low resilience behaviours are reduced and the underlying structure of behaviour (bout lengths, frequency of transitions between activities) is affected. These behaviours and their structure are unknown for beef cattle and technology is now available to autonomously monitor cattle behaviour. Our overarching objective is to benchmark key performance indicators of animal welfare, as derived by these transitions, from birth to slaughter for red meat production. Here we report on the validation phase (Phase 1) of our project.

Methods

Two experiments were conducted to validate observed and sensor derived behaviours states for Allflex-SCR ear tags and collars. Each experiment was conducted over 3 weeks with the experimental design repeated across each experiment. Experiment 1 validated Allflex collars for 40 multiparous Holstein cattle. Experiment 2 validated for 20 multiparous and 20 primiparous Angus beef cattle.

Results

Both ear and neck tags accurately estimated rumination and eating/grazing behaviour duration and timing with 90% agreement between observed and tag predicted states, particularly for behaviour states that had 'bouts' of behaviours, with bouts defined as a behaviour duration of greater than 1 minute. Both ear and neck tags had a low probability of agreement (25%) between observed and tag idle state.

Discussion/Conclusion

Both ear and neck tags can be accurately used to estimate rumination and eating/grazing behaviour duration and timing, particularly for behaviour states that last for more than 1 minute; which is most of the time for ruminants. Both ear and neck tags had a low probability of agreement between observed and tag idle state that constitutes idle in terms of observations and what the tag records as idle is another area for further research. For instance, repeated flicking of the ears or movement whilst lying or standing may be recorded as medium activity by the tags. Given the practical limitation of using collar-based tag systems in extensive systems, particularly for growing animals, we recommend the use of ear tags from this point on for this project. Heavy breathing is another state available on these tags, however, no heavy breathing occurred in the current experiments. Further work is required to validate this state for these tags.

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344 Changes to poll DNA testing for Australian beef cattle

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Introduction

The poll microsatellite DNA marker test has been used for poll testing Australia's beef industry since 2011, and largely relied on the submission of phenotypes (horned, polled, and scurred) as a reference dataset to estimate genotypes with an associated probability. Recently poll SNP based testing has become available, which does not require phenotype submission and provides a more conclusive genotype result. The following summarises changes to poll DNA testing, how tests differ and potential changes in genotype results.

Results and Discussion

Polledness has been determined to be an autosomal dominant gene; the presence of at least one poll allele will result in a polled phenotype, and the presence of two horned alleles will result in a horned phenotype. The scurs allele is under investigation, with the scurred phenotype proposed to be masked when homozygous polled or homozygous horned genotypes are present. Since 2011, Australia's beef industry used a microsatellite markers test developed by the BeefCRC for poll testing (Piper *et al.* 2014), for which the genotype estimations were driven by phenotypes submitted, forming a reference population. Simply, markers observed with horned phenotypes were assigned horned genotypes; markers observed with polled phenotypes were assigned polled genotypes. However, examination of data shows submissions were biased over time towards polled phenotypes and subsequently some genotype estimations were mis-assigned (e.g. horned markers were mis-assigned as polled, due to only being seen with polled phenotypes) (Connors *et al.* 2018). Recently, with the routine inclusion of SNP genotypes into BREEDPLAN single-step evaluations, industry poll testing has moved to a SNP-based test, providing results with any combination of Polled_{Celtic} (Pc), Polled_{Friesian} (Pf), or Horned (H). There is no requirement of phenotype to derive results, rather the test determines the presence or absence of SNPs.

Recent research has shown inclusion of accurate horned phenotypes in the marker poll test can shift mis-assigned genotypes, from polled (PP or PH) to horned (HH), depending on pre-existing phenotype observations. With mis-assignment of genotypes within the marker test, due to biased phenotype observations, it is possible animals may obtain a different result with the SNP test (e.g. microsatellite result of PP and SNP result of PH). Comparison of results between the SNP and marker poll tests show very high concordance, and any observed disagreement between results thus far has been due to mis-assignment of marker genotypes.

Conclusions

Poll testing for Australia's beef industry is now based on poll SNPs on commercial genotyping chips. The microsatellite marker poll test and SNP test have high agreement in results, however due to the differing methods, it is possible some results are conflicting. Importantly, this conflict is likely a reflection of biased phenotypes submission and the resulting reference population for the marker test.

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345 Tolerance of new *Stylosanthes* lines to leaf and stem diseases

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Introduction

In southern Queensland there are few legumes adapted to light-textured soils. In a Meat and Livestock Australia project, Department of Agriculture and Fisheries (DAF) staff are testing a range of *Stylosanthes* lines reselected from old plant evaluation sites within this region. Given previous failures of *Stylosanthes* cultivars due to anthracnose (*Colletotrichum gloeosporioides*), the team sought to assess susceptibility to disease prior to progressing promising lines to commercial production. Preliminary results are presented here.

Method

Nineteen genetic lines of *S. seabrana* and *S. scabra* were grown at DAF Walkamin in the humid tropics in north Queensland, an environment conducive to anthracnose infection. The lines were planted into replicated small plots in February 2019. Commercially released comparators, including an anthracnose susceptible variety (Fitzroy), were included. The lines were assessed monthly for leaf (LRAT) and stem disease severity (SRAT) and samples examined by government plant pathologists.

Preliminary Results

Anthracnose damage occurred in all lines of *Stylosanthes* including the characteristic 'target' leaf and stem lesions and branch breakages. Fitzroy stylo, and new lines 9 and 47, have the highest incidence of leaf and stem diseases to date (Fig. 1). Other new lines (25 and 48) appear the most resistant with the remaining lines and cultivars having intermediate values. Measurements will continue until the end of 2019.

Fig.1. Mean rating values on 15th July 2019 comparing leaf (LRAT) and stem (SRAT) disease severity for 19 genetic *Stylosanthes* lines (bars represent 2 standard errors of the mean).

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346 Rejuvenating the tropical forages genebank to develop new pasture cultivars

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The application of the Australian tropical forages genebank

Sown pastures are used in northern Australia to improve the nutrition of grazing animals through providing additional, or higher quality feed compared to natural sources of vegetation. Benefits to productivity from the development of tropical pasture grass and legume cultivars have accrued over some 50+ years (Walker *et al.* 1997), but there remains substantial opportunities to develop new pasture plants, particularly legumes in areas of moderate rainfall (Bell *et al.* 2016, Peck *et al.* 2011).

The Australian tropical forages collection, now held within the Australian Pastures Genebank (APG) underpins forage cultivar development in Australia. It comprises 10 100 warm season grasses and 7 350 legumes sourced from other tropical countries and within Australia over 40+ years.

Regeneration of the tropical forages collection

Depletion of seed stocks through use and loss of seed quality over 30+ years means the collection requires substantial regeneration for use by plant breeders. An initial regeneration was conducted by the Queensland Government in north Queensland, including 380 grasses (81 species) and 609 legumes (91) over 4 years from 2005 (Cox *et al.*, 2009). A more focussed regeneration began in 2015 with formation of the APG, using methods to better capture genetic diversity (more plants per accession) and produce more (5000+) viable seeds of each accession. Priority was on legumes for the seasonally dry areas, multi-purpose legumes and high-quality grasses (Table 1). Seeds were fully regenerated for 170 grasses and 318 legumes over 4 years. Traits useful for plant breeders were measured for each line compared to standard cultivars and the data transferred to a public access website for breeders to assess and request seeds for evaluation.

Table 1. Progress towards restoring stocks of priority germplasm. Bold - > 5000 viable seeds; (1000-5000)

Legume botanical name	Lines	Restored (%)	Legume botanical name	Lines	Restored (%)	Grass botanical name	Lines	Restored (%)
<i>Centrosema brasilianum</i> [^]	25	96 (4)	<i>Macroptilium atropurpureum</i> ^{^*}	42	95 (2)	<i>Alloterospis semialata</i> [#]	5	60 (40)
<i>Centrosema pascuorum</i> ^{^*}	20	100 (0)	<i>Macroptilium bracteatum</i> [*]	3	67 (0)	<i>Cenchrus ciliaris</i> [^]	15	93 (0)
<i>Centrosema pubescens</i> [~]	28	96 (0)	<i>Macroptilium fraterum</i>	5	100 (0)	<i>Cenchrus setiger</i> [^]	8	100 (0)
<i>Clitoria tematea</i> ^{^*}	7	100 (0)	<i>Macroptilium gracile</i> ^{^*}	24	96 (0)	<i>Dichanthium aristatum</i> [^]	24	96 (0)
<i>Crotalaria christantiflora</i> [#]	1	100 (0)	<i>Macroptilium lathyroides</i> ^{~*}	17	100 (0)	<i>Digitaria eriantha</i> ^{^*}	5	40 (20)
<i>Desmanthus acuminatus</i> [^]	10	80 (20)	<i>Macroptilium martii</i>	7	100 (0)	<i>Digitaria milanijana</i> ^{^*}	21	76 (0)
<i>Desmanthus bicornutus</i> [^]	14	86 (7)	<i>Macroptilium psammodon</i>	1	100 (0)	<i>Megathyrus maximus</i> ^{^~}	33	70 (0)
<i>Desmanthus covillei</i> [^]	5	80 (0)	<i>Macroptilium spp.</i>	2	50 (0)	<i>Panicum coloratum</i> ^{^~*}	34	79 (3)
<i>Desmanthus fruticosus</i> [^]	5	100 (0)	<i>Macrotyloma daltonii</i> ^{^*}	5	100 (0)	<i>Paspalum atratum</i> [~]	3	0 (0)
<i>Desmanthus glandulosus</i> ^{^*}	2	50 (0)	<i>Macrotyloma uniflorum</i> [*]	6	100 (0)	<i>Urochloa brizantha</i> ^{~*}	8	100 (0)
<i>Desmanthus leptophyllus</i> ^{^~*}	11	91 (0)	<i>Stylosanthes calcicola</i>	8	75 (0)	<i>Urochloa decumbens</i> ^{~*}	9	100 (0)
<i>Desmanthus tathuyensis</i> [~]	1	100 (0)	<i>Stylosanthes guianensis</i> ^{~*}	5	100 (0)	<i>Urochloa mosambicensis</i> [^]	21	100 (0)
<i>Desmanthus virgatus</i> [^]	21	95 (5)	<i>Stylosanthes hamata</i> ^{^*}	5	80 (0)	<i>Urochloa oligotricha</i> [~]	12	100 (0)
<i>Lablab purpureus</i> [*]	30	93 (17)	<i>Stylosanthes scabra</i> [^]	19	89 (10)	<i>Urochloa ruzizensis</i> [~]	5	80 (0)
<i>Macroptilium affine</i>	1	100 (0)	<i>Stylosanthes seabrana</i> [^]	13	100 (0)			

[^] pasture extended dry season

[~] pasture limited dry season

^{*} multi-purpose (eg ley, fodder bank, hay)

[#] research request

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347 Seed production of some promising new grasses for seasonally dry areas of northern and central Queensland

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Introduction

The use of sown pastures has been shown to increase the productivity and profitability of beef growing and breeding enterprises in seasonally-dry areas (Partridge and Miller, 1991), but a range of recently developed grasses and legumes had not been assessed in key beef production land-types in north and central Queensland. Targeting improved nutrition of younger livestock in ‘weaner’ type paddocks, DAF researchers, with co-funding from Meat and Livestock Australia, evaluated up to 29 legumes and 30 grasses across a range of land-types in seasonally dry areas of north and central Queensland using replicated small-plots under grazing (B.NBP.0766, Cox et al., 2019). Promising grasses included newer taxa with limited previous seed production in Australia: *Panicum maximum x infestum* ‘Massai’ and ‘NuCal’ and a ‘green-type’ *Panicum coloratum* var. *coloratum* ATF714. Under B.NBP.0812, seed production (240-660 m² crops) was undertaken at DAF Walkamin in north Queensland, the principal seed production area of Australia, to supply seeds for further evaluation and identify yield potential and management guidelines for commercial adoption.

Seed production methods and performance

Seed production methods representative of local commercial practice were used: basal application of phosphorous, sulphur and potassium fertilisers; 100-120 kg/ha soluble nitrogen applied after cleaning cuts to stimulate tillering, and; irrigation to supplement rainfall. Two seed crops of each line were grown and starting dates were varied to indicate the influence of photoperiod on flowering (Table 1). Small-scale combine harvesters were used once harvest ripeness was identified by examining caryopses and seed lots were conventionally dried, cleaned and stored.

The green *P. coloratum* produced moderate seed yields when started in the wet season but readily shed seed when mature likely resulting in losses due to poor weather at harvest. Alternative harvest strategies may increase recovered seed yields. The two *Panicum* hybrids showed strong evidence of a short-day flowering response at 17°S and produced commercially useful seed yields when management was optimal. A high proportion of empty florets was removed during cleaning.

Table 1. Cleaned and dried seed yields of three new grass taxa. Starting and harvest dates MM/YY.

<i>Panicum coloratum</i> ATF714			<i>Panicum</i> hybrid Massai			<i>Panicum</i> hybrid NuCal		
Sow/start date	Harvest date	Yield (kg/ha)	Sow/start date	Harvest date	Yield (kg/ha)	Sow/start date	Harvest date	Yield (kg/ha)
12/16	1/17	26	2/16	4/16	260	2/16	4/16	83
1/17	3/17	55	3/17	5/17	133	3/17	5/17	161
-	12/17	20	3/17	5/17	172	3/17	5/17	194
1/18	4/18	58	1/18	5/18	152	1/18	5/18	124
1/18	4/18	80	4/18	5/18	7	4/18	5/18	10

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348 Plant evaluation within ACIAR projects can provide mutual benefits for northern Australia and regional neighbours

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Introduction

Sown pastures are used in northern Australia to improve the nutrition of grazing animals through providing additional, or higher quality feed compared to natural sources of vegetation. Recent reviews of historical plant evaluation data and pasture rehabilitation methods emphasise opportunities to develop pasture legumes in areas of moderate rainfall to improve grass-legume pasture productivity and reduce productivity losses due to pasture nitrogen rundown (Bell *et al.* 2016, Peck *et al.* 2011). There are also opportunities to capitalise on recently imported international grass and legume cultivars principally targeting areas of moderate to high rainfall (Cox 2014).

Collaborative research: the Australian Centre for International Agricultural Research (ACIAR)

Countries in our local region share similar challenges to northern Australia when developing a feed-base for beef cattle, including similar soils and rainfall environments. Rigorous testing and development of new forages can be mutually beneficial, but such activities come at a considerable cost and this can limit the capacity of research teams to complete the work.

Projects developed and co-funded through ACIAR provide an opportunity to conduct research to benefit partnering countries and Australia. Two recent examples include ACIAR projects led by CSIRO (Dr Lindsay Bell) and the University of Queensland (Dr Simon Quigley) with Australian contributions from the (Queensland) Department of Agriculture and Fisheries:

1. *Integrating herbaceous forage legumes into crop and livestock systems in Eastern Indonesia.* Legumes were tested for productivity as green and conserved forages in seasonally dry environments of Indonesia with similar soils to northern Australia (Nulik *et al.* 2013). *Clitoria ternatea* was found to be particularly productive and performed well in preliminary field evaluation as a hay legume in north Queensland (Cox *et al.* 2016).
2. *Increasing the productivity and market options of smallholder beef cattle farmers in Vanuatu.* Promising grasses and legumes previously imported into Australia, but not yet tested in wet tropical environments shared by Vanuatu and northern coastal Queensland, were assessed under regular cutting compared to older varieties (Natapu *et al.* 2017). Useful yield data confirmed the potential of some newer grasses and legumes, but also the utility of some older types. There may be merit in field testing combinations of the more promising grasses and legumes under grazing in northern Australia.

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349 Understanding the influence of Angus genetics and associated genetic technologies in the Northern Australia Beef Industry

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Introduction

It is commonly recognised that Angus genetics and associated genetic technologies (e.g. Estimated Breeding Values, genomics) have made a significant contribution to the wider beef industry in terms of lifting productivity through gene introgression and genetic gain for commercially relevant traits. However there have been few wide scale studies that have been undertaken to understand this formally, particularly in relation to the Northern Australia beef industry.

To provide this understanding, Angus Australia has facilitated a study by way of quantitative survey methodology via an independent market research group. The study will determine the level of penetration of Angus and Angus influenced genetics throughout Australia, including northern Australia, in addition to gauging beef producer's knowledge and attitudes towards the associated genetic technologies.

More specifically, the quantitative survey, conducted across May and June 2019, will provide responses from 1000 beef producers across Australia. The findings will be used as a baseline level in which to measure practice change over a 5-year period to 2023, when a second quantitative survey will be undertaken using the same methodology.

This paper focusses on the findings from the first phase of surveying, with emphasis on results and insights for the Northern Australia beef industry.

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350 Black Basalt Country Rehabilitation

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Introduction

The degradation of black basalt country has been recognised as a problem in north Queensland's extensive grazing lands at least since the early 1990's. Research has been undertaken by CSIRO (McIvor and Gardiner 1995; Ash et al. 2001) at Hillgrove Station on the management of basalt country from 1981 to 2000, however only the red basaltic soils were the focus of this work. Research work conducted by CSIRO and James Cook University at Fletcherview Research Station in the late 1990's studied the grazing preference by cattle on red basalts, black basalts, Burdekin loamy alluvials and box country (Ash et al. 1996). Grazing preference on the black basalt pastures resulted in utilisation rates that were two times greater than on the red basalts and the alluvial country. In 2014 the Department of Agriculture and Fisheries (QLD) provided funding for the Dalrymple Landcare Committee Inc. to establish a demonstration site using sown pastures to rehabilitate degraded black basalt country in the Upper Burdekin. Basalt River station was selected as the demonstration site.

Methods

The economics of rehabilitating degraded black basalt country were assessed based on the pasture response, land condition and carrying capacity of each treatment at the site. The pasture was sown and land prepared using three different treatments; crocodile seeder, offset disc plow and three-tynd deep ripper. The economics were assessed based on 100ha using Land Reclamation Economics Spreadsheet tool (Moravek 2013). The regenerated pastures had greater than 10 per cent legumes present which assumed a live weight gain advantage of 37kg per year. This improved gross margin from \$195/AE to \$201/AE after regeneration.

Results

The property demonstration site has been monitored for three years since December 2016. In April 2019 crocodile seeder and discing treatment sites were in land condition A and deep ripping treatment site was in land condition B. It has been assumed that all treatments reach and maintain land condition A from year four onwards.

Table 1. Rehabilitation results.

	Crocodile seeder	Discing single pass	Deep ripping
Total preparation cost (\$/ha)	264	314	429
Net present value (\$)	46 367	43 257	26 423
Payback period (years)	9	10	14

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35 | Is your pasture monitoring and cattle performance linking with your FNIRS samples?

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Introduction

Beef producers are encouraged to monitor their pasture, diet quality and livestock performance as a basis for making decisions e.g. supplementation, to improve their business. However, the link between pasture and livestock performance indicators may not always be apparent, particularly if monitoring occurs infrequently or livestock response is measured at the end of the period of interest e.g. weaning rates. We tested the relationship between pasture diet quality and herd body condition at Brian Pastures Research Facility, located near Gayndah in South East Queensland, using a framework that has been put in place since 2016, to monitor cattle performance and grazing management.

Methods

Number 16 heifers (born late 2015) were monitored for approximately 2 years, from shortly after weaning until just prior to calving. Monthly cattle body condition, diet crude protein, and dry matter digestibility (DMD) using faecal samples for FNIRS analysis (Faecal Near Infrared Spectroscopy) was recorded. The paddocks that are grazed during monitoring were assessed for pasture composition, pasture yield (kg/ha DM), percent green pasture and a photo was taken using the procedures in Stocktake (The State of Queensland 2004)

Results and Discussion

Crude protein and DMD dropped to, or below the 6% and 50% thresholds for maintaining weight, during the periods June to September 2017 and April to July 2018. In 2017, supplementation should have commenced earlier in June rather than July. The need for supplementation was overlooked due to the heifers apparently holding body condition (average score 4) despite digestibility and protein levels falling below optimum levels. When crude protein and DMD dropped below the thresholds, there was a decrease in average weight of -0.27kg/day. Similarly, supplementation in 2018 could have begun slightly earlier to maximise body condition and heifer weight at calving. This framework has demonstrated the importance of regular diet quality monitoring influences key decision making, such as timing of supplementation, prior to heifer body condition loss being visually apparent.

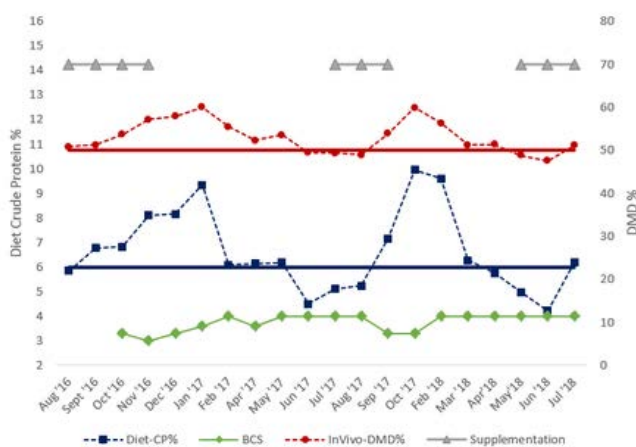


Fig. 1. Pasture crude protein, dry matter digestibility, average body condition score (BCS) and supplementation period (grey line) from August 2016 to July 2018. Solid blue line is 6% Crude Protein threshold. Solid red line is 50% DMD threshold.

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352 Adsorbents for the sequestration of the Pimelea toxin, simplexin

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Introduction

Pimelea poisoning affects cattle grazing arid rangelands of Australia. It is attributable to consumption of native Pimelea plants containing the toxin simplexin, an unusual daphnane orthoester (Chow et al. 2010). Significant outbreaks can cost the beef industry \$50 million per annum, and there is currently no effective preventative treatment available. This work investigated the potential for commercially available adsorbents to sequester simplexin to reduce its potential bioavailability.

Methods

In an *in vitro* experiment, the effectiveness of 3 adsorbents to bind simplexin was examined using a rumen fluid-based media. Experiments used a constant amount of simplexin (1,000 ng/mL) and increasing quantities (4, 12, 20 and 28 mg/mL) of each adsorbent: sodium bentonite (Trufeed®, Sibelco Australia), biochar (Nutralick®, Sibelco Australia) and Elitox® (Impextraco, Belgium). Unbound simplexin concentrations were measured using an UHPLC-Orbitrap high-resolution mass spectrometer method.

Results and Discussion

Sodium bentonite (n=16) was significantly more effective at adsorbing simplexin compared to the other materials with ≥ 12 mg/mL of adsorbent (Fig. 1). For biochar (n=13) and Elitox (n=17), a gradual increase in simplexin adsorption was observed with increasing amounts of adsorbent material. Test samples containing 4 mg/mL of adsorbent material were not significantly different to the blank (n=8).

Fig. 1. Mean results (\pm SD) for adsorbents: Bentonite, Biochar, Elitox, Blank (no adsorbent).

Conclusion

This is the first study to demonstrate the effectiveness of these adsorbents to bind simplexin. Future research will explore the fundamental properties behind the binding activity, and the effect of pH changes to simulate passage through the gastric system including abomasum and small intestine.

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353 Genetic and non-genetic effects gestation length on northern Australian tropically adapted beef breeds

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Introduction

Decreasing gestation length (GL) has been shown to reduce calving difficulties and help maintain an annual calving pattern (Jeyaruban *et al.* 2016). Although a simple trait by definition currently it is only recorded for animals mated by Artificial Insemination (AI), and this limits the available number of records. There have been no recent genetic parameters estimates for tropical breeds in Australia, and very few available estimates elsewhere. The aim of this study was to estimate the genetic and non-genetic effects for GL in northern Australia beef breeds.

Materials and methods

GL was recorded for 1,501 for calves generated by AI in the 'Repronomics' project between 2014 and 2018. Project design are outlined in Johnston *et al.* (2017). Cows were located at two locations and three breeds were considered; Brahman (BB), Droughtmaster (DM) and Santa Gertrudis (SG; at one location only). After basic data edits the final dataset contained 1,469 gestation length records sired by 67 different sires. There were 699, 592 and 178 records for BB, DM and SG animals, respectively. Within breed non-genetic factors were considered using the PROC MIXED in SAS and included calf cohort, lactation status, calf sex, calf sire, insemination round and cow origin and age group. Genetic parameters were estimated for a pooled data set across breeds and significant fixed effects using a mixed linear animal model in ASReml.

Results and discussion

The average raw GL was 289.5 days and there were differences between breeds with average GL of 291.6, 288.4 and 284.9 days, respectively for BB, DM and SG. Within each breed there was large variation in GL ranging from a 27 days for SG to a 40 day spread in DM. Very few non-genetic factors were significant; only calf sex and calf sire was significant for all three breeds considered. For BB, the calf cohort was also found to be significant. Least square means showed male calves had longer GL by 3.3, 1.9 and 3.3 days, respectively for BB, DM and SG. There were large differences between calf sire least square means with sire least square means ranging 6.4, 12.9 and 14.3 days, respectively for SG, DM and BB. GL was estimated to be highly heritable ($h^2=0.82$ (0.08)) with a phenotypic variance of 30.3 days. The data structure did not allow maternal effects to be partitioned and any maternal effects are included in the direct heritability estimate. In *Bos taurus* breeds, Jeyaruban *et al.* (2016) also estimated gestation length to be highly heritable with direct heritabilities between 0.42 and 0.52 and maternal heritabilities between 0.03 and 0.09. GL is under genetic control in tropical beef breeds and therefore needs to be considered in the experimental design of AI programs and also in selection.

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354 Development of a mixed bacterial inoculum to detoxify the *Indigofera* toxin indospicine in the rumen – one step closer.

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Introduction

The palatable legume *Indigofera spicata* contains the natural toxin indospicine, a non-proteinogenic analogue of the amino acid arginine. Indospicine is known to cause hepatotoxicosis and abortion in cattle, which have consumed *Indigofera*-contaminated pasture. This natural toxin also accumulates in cattle tissues, and residues can persist for 3 months after exposure. Previously we have demonstrated that the rumen microbial population is capable of degrading indospicine before absorption (Tan et al. 2017). In the current study we investigated the fate of indospicine in a controlled *in vitro* rumen-like fermentation and the associated microbial changes during the 14 day fermentation.

Methods

Dried and ground *I. spicata* plant material (10 g) was fed daily for 14 days to an anaerobic *in vitro* fermentor (3L volume, Infors HT) to mimic the rumen fermentation process of cattle. Rumen fluid collected from cattle previously grazing pasture containing *Indigofera* was used as a microbial starter. Fermentor fluid was collected daily and analysed for the concentration of indospicine and its metabolites by LC-MS/MS. DNA was extracted from fermentor fluid, and utilised for microbial diversity profiling (barcoded V3-V4 16S rRNA gene amplicon) using the Illumina MiSeq sequencing platform.

Results and Discussion

The rate of indospicine degradation increased slowly during the first week, reaching 100% after 7 days of fermentation. The bacterial community changed significantly throughout the 14 day fermentation, with most changes occurring during the first 7 days of the fermentation, as the microbes adjusted to the *Indigofera* plant material and the growth conditions provided by the fermentor. Microbes classified within the classes Bacterioidia, Clostridia and Campylobacteria, increased in abundance during the course of the fermentation. Whereas microbes classified within the classes Negativicutes and Bacilli, which were dominant at the beginning of the fermentation, were significantly less abundant after 14 days of fermentation. As microbial populations within the fermentor changed and adapted to more effectively break down the *Indigofera* plant material, a corresponding increase in the ability to degrade indospicine was observed, with indospicine being completely degraded from days 7 to 14 of the fermentation.

Conclusion

After 7 days of *in-vitro* fermentation a stable population of rumen micro-organisms were able to fully degrade indospicine within 24h, and this was maintained for a further 7 days. This study therefore represents “proof-of-concept” and the first stage in the development of a microbial inoculum which could be used to enhance the capacity of cattle to degrade the toxin indospicine *in vivo*.

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355 Risk of indospicine accumulation in bovine tissues from north-west Australia

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Introduction

Indigofera plant species, including the native Australian *I. linnaei*, are resistant to drought and palatable to grazing livestock. However, *I. linnaei* contains the natural toxin indospicine, which accumulates in tissues of animals (including cattle) grazing on this perennial legume. The residues can persist for three months after exposure and there have been reports of hepatotoxicosis and mortalities in dogs after dietary exposure to indospicine-contaminated horse and camel meat. Since the risk for human consumption to date is unknown the current study was undertaken to assess indospicine levels in cattle going to slaughter from divergent regions of Western Australia, and to predict the likelihood of significant residues being present.

Methods

Muscle and corresponding liver samples from 776 cattle originating from the Kimberley and Pilbara Regions in Western Australia, where *I. linnaei* is prevalent, as well as 640 cattle from the South West and South Coast Regions of WA, where the plant is not known to occur, were collected at abattoirs over four seasons in 2015-2017. Indospicine levels were measured by LC-MS/MS.

Results and Discussion

The indospicine concentrations ranged from below detection to 3.63 mg/kg. No indospicine residues were detected in any of the animals originating from the South West and South Coast Regions. The overall prevalence of indospicine residues from the Kimberley and Pilbara Regions throughout the survey period was 62% of all animals with a prevalence of up to 90% in autumn in the Kimberley Region, where in some consignments and properties almost all animals tested positive. @Risk best-fit probability distributions showed ninety-fifth percentile (P95) indospicine concentrations of 0.54 mg/kg for muscle and 0.77 mg/kg for liver in cattle originating from the Kimberley and Pilbara Regions during the survey period. (Netzel et al. 2019)

Conclusion

Considering the average Australian meat consumption data (ABS 2014), the estimated consumer exposure from the P95 muscle was 0.32 µg indospicine/kg bw/day, which compared favourably with our calculated provisional tolerable daily intake (PTDI) of 1.3 µg indospicine/kg bw/day. However, canine exposure is of potential concern, with active working dog exposure calculated to exceed this PTDI by a factor of 25, based on a P95 indospicine concentration of 0.54 mg/kg in muscle.

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356 Calves walk less when placed with a social facilitator cow at weaning

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Weaning beef calves commonly involves complete separation of cows from their calves, and results in atypical walking and vocalizing behaviors by calves that are detrimental to calf growth and health. Weaning is considered a necessary management practice, however, to improve cow reproductive success and to prepare calves for the receiving, growing, and finishing phases of production. The present study proposes an alternative weaning strategy, with the objectives of evaluating the addition of a social facilitator cow at weaning to reduce stereotypical walking behaviors and improve calf growth. We hypothesized that calves placed with a social facilitator would have decreased distances walked and time devoted to walking compared with control calves. Utilizing global positioning system (GPS) technology, we were able to determine total distance walked, total time walking, and area of the pasture utilized by the calf. Angus x Simmental heifer calves ($n = 80$) were used in this study, and in all four replications calves were allotted to each treatment group ($n = 10$), social facilitator (SF) or control (CON) on the day of weaning (day 0). Calves in the SF group were placed on pasture at weaning with a familiar social facilitator, and control calves were placed in a similar size pasture without a social facilitator. All calves and social facilitators were allocated their own GPS tracking device on days 0 (weaning), 7, and 14 for 24 hours before removal. Data were analyzed as a randomized complete block design with repeated measurements (SAS 9.4), and descriptive statistics were calculated for the social facilitators. Placing calves with a social facilitator decreased the distance walked ($P < 0.01$), and the amount of time calves devoted to walking ($P < 0.01$). The SF calves walked similar distances to their respective social facilitator cow on day 0, 7, and 14, with the calves and cows having their greatest walking distance on day 0 and this distance decreasing with each subsequent sampling day. Placing a social facilitator with calves at weaning, therefore, has an effect on walking distance and amount of time calves devote to walking.

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357 Rumen efficiency and nitrogen preservation of cattle

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Introduction

The rumen efficiency in converting available energy and nitrogen into microbial protein (MCP) is highly variable and fundamental to determine the performance of ruminants. In protein-limiting diets, better rumen efficiency can help to preserve the available nitrogen. The objective of this study was to investigate whether the rumen efficiency of cattle in using diet protein (EMPS1) was related to nitrogen excretion in urine.

Method

Twenty-eight Brahman steers were fed a protein restricted diet (LP) for 70 days providing 70% of the predicted required rumen degradable protein (RDP; 95 g RDP/kg DOMI), followed by 70 days on a high protein diet (HP; 145 g RDP/kg DOMI) providing 100% of the predicted RDP and were then classified into high (H), medium (M) or low (L) based on ± 0.5 standard deviation from mean EMPS1. Rumen efficiency was determined after 7 days in metabolism crates and was defined as a) g of MCP per amount of crude protein intake (CPI; EMPS1) and b) g MCP per amount of digestible organic matter intake (DOMI; EMPS2). MCP was estimated by excretion of purine derivatives in urine.

Results

Steers classified as more efficient in transforming diet protein into microbial protein had similar DM intake and overall nitrogen use efficiency (NUE) on both diets (Table 1). Rumen efficient steers also had greater EMPS1 (by design), MCP, and EMPS2 on both diets. Steers with the lowest EMPS1 in the LP diet, but not in the HP diet, excreted a higher proportion of N intake in urine.

Table 1. Effect of rumen efficiency group [Low (L), Medium (M) or High (H)] on rumen efficiency parameters and N metabolism of Brahman steers

Items	Diet LP					Diet HP				
	L	M	H	SEM	LxH ^A	L	M	H	SEM	LxH ^A
EMPS1 (g MCP/kg CPI)	677	886	1309	40	<0.01	543	818	1555	59	<0.01
MCP (g MCP/100 kg BW)	50	66	85	3.6	<0.01	79	111	189	10.5	<0.01
EMPS2 (g MCP/kg DOMI)	60	71	103	3.4	<0.01	81	122	215	10.1	<0.01
DMI (kg DM/100 kg BW)	1.32	1.52	1.45	0.07	0.17	1.43	1.37	1.36	0.06	0.50
N excretion in urine (g N Urine/100 g N intake)	53.3	36.5	38.9	4.1	<0.01	69.9	65.8	61.6	7.2	0.31
NUE (g N retained/g N digested)	11.8	31.7	19.0	7.1	0.40	4.9	4.5	5.6	12.8	0.97

^AContrast between the L and H groups within diets.

Discussion

Rumen efficiency is an important mechanism governing overall feed efficiency of ruminants. The present study demonstrates that EMPS1 of cattle in the LP diet was connected with conservation of N, as more efficient animals excreted less N in urine. This was not the case for the HP diet, suggesting that different mechanisms regulate rumen efficiency in LP and HP diets.

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358 Using live yeast to improve forage digestibility and performance of steers

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Introduction

Northern Australia's pastoral lands often experience short rainfall for extended periods of the year, hence not being uncommon for cattle to perform poorly, or even lose weight due to low quality of grasses in those conditions. To overcome this problem, producers engage in supplementary feeding, emphasizing the use of small amounts of protein. The addition of rumen specific live yeast (LY) to supplements may increase the use of forage by establishing a healthy gastrointestinal tract and increasing digestibility. The objective of this experiment was to evaluate LY added to a dry lick protein supplement. It was hypothesised that LY would enhance rumen forage digestibility and therefore increase dry matter (DM) intake and average daily gain (ADG) of growing steers consuming a low crude protein (CP) tropical forage.

Method

To evaluate the effects of LY inclusion on performance of growing cattle, forty-eight Charbray steers [329 kg ± 20 kg liveweight (LW)] were ranked by LW into two blocks and randomly allocated into twelve pens (n=4/pen). The steers were fed *ad libitum* a Rhodes grass hay (6% CP) and 220 g/head.day of a loose lick protein supplement for 56 days. Supplements contained either 0 (Control) or 8 x 10⁹ CFU of *Saccharomyces cerevisiae* CNCM I-1077 (LY)/day. Hay and supplement intake were measured for each pen throughout the trial. Steers were weighed post adaptation period and every fourteen days thereafter for two consecutive days. Faeces were collected twice each day during the final five days of the experiment and analysed for indigestible neutral detergent fibre (iNDF) as a marker to estimate digestibility.

Results

There was no effect ($P > 0.50$) of LY on hay, supplement or total DM intake. However, LY supplementation tended to increase ADG by 27.6% ($P = 0.08$) and feed efficiency by 30% ($P = 0.10$). Supplementing with LY did not increase total DM digestibility ($P = 0.97$) as measured by iNDF in the faeces and the diet.

Table 1. Effect of live yeast (LY) supplementation on intake and performance of growing steers.

Parameter	Control	LY	SEM	P-value
Hay intake (kg DM/100 kg LW.day)	1.72	1.78	0.08	0.52
Supplement intake (g DM/100 kg LW.day)	49.5	48.7	3.46	0.87
Total intake (kg DM/100 kg LW.day)	1.78	1.83	0.08	0.62
initial LW (kg)	327	318	19	0.15
Final LW (kg)	351	349	23	0.75
Average daily gain (g)	424	541	75	0.08
Gain to Feed ratio	0.066	0.086	0.008	0.10

Discussion

The initial hypothesis that LY supplementation could increase intake due to greater fibre digestibility was not observed in the current experiment. Most likely, the increase in ADG and feed efficiency reflect a more efficient rumen fermentation in supplemented animals.

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359 The impact of a single treatment of injectable doramectin on weight gain post weaning in beef heifers and steers in central Queensland

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Introduction

The benefit of drenching weaned cattle in northern Australia has been debated for some time. The macrocyclic lactone (ML) family of drenches have been available in Australia for nearly 30 years, but there are no publications in the refereed scientific literature outlining the relative benefit of using these products to treat young beef cattle in northern Australia. The objective of this study was to demonstrate the impact of a single drench with a label dose of injectable doramectin (an ML) subsequent to weaning on the growth and performance of heifers and steers in central Queensland beef herds.

Methods

Three studies were undertaken on recently weaned *Bos indicus* cross beef calves with 75% or greater *Bos indicus* content on two farms in central Queensland, just north of the tropic of Capricorn. Farm 1 was located 50 km north and Farm 2 75 km north-west of Rockhampton. In each study, half of a group of recently-weaned beef calves were treated by random allocation with 0.2 mg/kg of injectable doramectin, with the remainder acting as un-treated controls. Study one (Farm 1) enrolled 250 heifers, while studies two and three (Farm 2) both enrolled 200 steers and 200 heifers. The farms involved did not historically use macrocyclic lactone based drenches on their cattle. There were varying periods of follow-up, with treated and control cattle pastured as one group throughout the study period. Worm burdens were monitored using standard faecal egg counts and larval differentiation procedures. In all studies, the worm genera present were a mix of *Cooperia* spp, *Haemonchus* spp and *Oesophagostomum* spp.

Results

In study 1, conducted on Farm 1 beginning 9 July 2012, doramectin treated cattle gained an average of 0.27 kg/day while control cattle gained 0.19 kg/day over a monitoring period of 121 days ($p < 0.0001$). In study 2, conducted on Farm 2 beginning 28 July 2015, doramectin treated cattle gained an average of 0.15 kg/day vs 0.145 kg/day in the control group ($p = 0.44$) over a 231 day study period. In study 3, conducted on Farm 2 beginning 4 August 2016, doramectin treated steers and heifers gained an average of 0.431 and 0.402 kg/day vs 0.342 and 0.311 kg/day in the control group, respectively, over the first 91 days of the study ($p < 0.0001$ in both cases). The differences in ADG in subsequent time periods were not statistically significant for steers or heifers. However, overall differences in ADG from Day 0 remained statistically significant out to Day 258, when the study ended for the heifers. By Day 594, when the study ended for the steers, the difference in ADG was no longer significant.

Discussion/Conclusion

Treatment with injectable doramectin soon after weaning resulted in improved weight gain in the 3 months after weaning in two of the three studies. The impact was eroded with time, but this may be an artefact of the study design. For further information, consult Taylor and Hodge 2019.

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360 Assessing the value of whole genome sequence in selecting for age at puberty in tropically adapted beef heifers

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Introduction

Genomic selection (GS) for age at puberty has been shown to be viable in tropically adapted heifers, and could potentially improve cow lifetime productivity, however, the accuracy of selection has been low (Farah *et al.* 2016). The aim of this project is to determine if whole genome sequence (WGS) data may be used to improve selection accuracy of age at puberty (AP) across a number of tropically adapted beef breeds.

Methods

Data was obtained from the Queensland Smart Futures research herd (Burns *et al.* 2016). Imputed WGS data for heifers was used to identify single nucleotide polymorphisms (SNP) that were associated with a proxy for AP, cycling or not by 600 days (Reproductive Maturity Score, RMS), in a meta-analysis of genome wide association studies (GWAS) across multiple populations. These SNP were included in an additional genomic relationship matrix that was used to perform GS. Three commercially available marker panels were used for GS, the BovineLDarray (6K), the BovineSNP50 BeadChip (50K) and the BovineHD array (800K). Accuracy was measured as the correlation between GEBV and the adjusted RMS phenotype in an independent subset of the data.

Results and Discussion

Correlations between GEBV and adjusted RMS phenotype are shown in Table 1. Accuracy of selection was improved most through the use of higher density marker panels. The addition of WGS GWAS data improved selection accuracy by a small amount (not significant) in this analysis.

Table 1. Average correlation between GEBV and Reproductive Maturity Score by marker panel.

Analysis	Correlation (s.e)
6K	0.16 (0.02)
6K plus WGS	0.18 (0.02)
50K	0.18 (0.02)
50K plus WGS	0.18 (0.02)
800K	0.19 (0.02)
800K plus WGS	0.20 (0.02)

Conclusions

Further research is required to determine the most effective way to utilise WGS data to improve the accuracy of selection for AP in tropically adapted heifers.

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361 Physiological and metabolic responses of grain fed cattle to moderate and high heat load.

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Introduction

High heat load is experienced by most cattle in Australia's northern production systems during summer. Feedlot cattle on a finisher ration and close to market weight are particularly vulnerable to high loads. Furthermore, with increasing average night-time temperatures, the overnight reduction of heat accumulated during the day is hampered. Cattle attempt to reduce effects of high heat load by reducing feed intake, and increasing water consumption to sustain sweating, and panting. The reduced feed intake, and an often extended recovery period leads to production losses.

Our recent studies on the physiological and metabolic impacts of high heat load on feedlot cattle, and how they recover provides new information to help management prepare for forecasted heatwaves and pathways for efficient recovery.

Method

We have developed protocols to measure the effects on performance, physiology, metabolism and endocrine responses of grain-fed Black Angus steers when exposed to 2 levels of heat load. The heat challenge experiments were conducted in climate controlled rooms at The University of Queensland QASP facility at Gatton, Queensland. A Moderate Heat Load regime exposed 6 steers in two cohorts to a 5 day interval of moderate heat load with a daily maximum of 35°C. This HOT period was book-ended by 5 days in thermoneutral conditions. For the Moderate Heat Load regime, a Control treatment subjected two cohorts of 6 steers to thermoneutral conditions for the duration but they were feed restricted based on the intake of the HOT animals.

Two cohorts of 12 steers were exposed to a High Heat Load regime which entailed sudden high heat load (41°C daily maximum for 3 days) followed by 2 days with 36°C daily maximum, and 2 days with 32°C daily maximum. As with the Moderate regime, the cattle were held in thermoneutral conditions before and after the heat load challenge. There was no thermoneutral feed restricted Control group for this experiment.

Cattle were maintained on a grain ration at all times. Data collected included panting scores, respiration rates, feed and water intake, and live weights. Frequent blood collection enabled measurement of blood enzymes, metabolites and hormones.

Results/Discussion

Besides the obvious decline in feed intake and increased respiration, our studies revealed the wide ranging and systemic impacts on metabolism and hormones, implicating the liver, kidneys, bone and N metabolism. The high heat load animal that voluntarily reduces feed intake is very different to the underfed animal. Not surprisingly, increased heat load generally caused a deeper response and longer recovery. The high heat load climate chamber protocol is applicable to test new rations and management interventions to prepare for and recover from heatwave events. Also we can assess the heat load tolerances of different cattle breeds, and their crosses and composites.

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362 Northern BIN Steer Project Update

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Introduction

The Droughtmaster Stud Breeders Society (DSBS), Australian Brahman Breeders' Association Limited (ABBA) and a consortium of Santa Gertrudis Breeders are currently conducting a joint progeny test project with funding assistance from the Meat & Livestock Australia Donor Company under the Beef Information Nucleus (BIN) program. This joint Northern BIN Steer Project has utilised the steer progeny from a second MLA funded project '*Enabling genetic improvement of reproduction in tropical beef breeds (Repronomics)*'

Materials and Methods

The project has currently purchased six cohorts of steers from Spyglass, Charters Towers and four cohorts of steers from Brian Pastures, Gayndah. The Northern BIN Steer Project will provide data which will assist in the implementation of a Multi-Breed database and a future Tropical crossbred analysis. This is possible as the Brahman and Droughtmaster steers (at Spyglass and Brian Pastures) and also Santa Gertrudis steers at Brian Pastures have been run together since birth, having only been split during the joining period of their dams in the Repronomics Project.

Both 400 and 600 day weights have been or will be collected for all steers. Steers are scanned for rib fat, rump fat, intramuscular fat measurement (IMF) and eye muscle area (EMA) at the 600 day weight measurement, as is a structural soundness assessment. Full MSA chiller assessments will be conducted on the steer carcasses, and meat samples from all steer carcasses will be analysed by the UNE Meat Science Lab for tenderness, cooking loss, meat colour and IMF. All data collected as part of the project will be submitted to BREEDPLAN. Tail hair samples will be a source of DNA information for future development and validation of genomic based technologies.

Results and Discussion

To date, the Northern BIN Steer Project has purchased 1,818 steers. The sires of the project steers are either proven sires with a large number of registered progeny (few of which have been performance recorded with BREEDPLAN) or young up and coming bulls. Of these steers, 1314 have been carcass scanned and 1047 have carcass data collected in the abattoir.

Although there is less than 100 days difference in age within each cohort, results show a large variation in all traits measured between individual animals and also within sire's progeny when compared against other sires.

The Northern BIN Steer Project will provide vital data that will assist in rapidly increasing the accuracy of genetically describing carcass and growth traits for Droughtmaster, Brahman and Santa Gertrudis cattle. Along with fertility data being collected from the Repronomics project, the Northern BIN Steer Project will help the breeds drive genetic progress for the important traits in the future.

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363 The genetics of low birth weight and relationships with calf survival in tropically adapted beef cows

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Introduction

Research investigating factors which contributed to post-natal calf mortality in tropically adapted beef cows (Bunter *et al.* 2014) showed that low birth weight was significantly associated with higher calf losses. This study aimed to identify whether a critical calf birth weight could be identified, below which post-natal losses were disproportionately high, and to examine the genetics of such a trait.

Materials and methods

Birth weight (BWT), and a binary trait which identified whether viable calves survived to weaning (1) or not (0) (DWEAN: as defined by Bunter *et al.* (2014)) were analyzed for 9296 calves, which were the progeny of 954 Brahman (BRAH) and 1089 Tropical Composite (TCOMP) cows from up to 6 matings. Logistic regression, as described by Bunter *et al.* (2014), was applied to identify whether a critical birth weight, below which calf losses were disproportionately high, could be identified, by fitting DWEAN as the dependent variable, and BWT in 2kg classes as a fixed effect, in a model which contained all other significant fixed effects for BWT (Bunter *et al.* 2014). Following these analyses an additional binary trait (BWT28) was defined which identified calves which were born at or below (0), or above (1) 28kg. Variance components for BW28 were estimated using logistic regression in ASReml, with sire fitted as random and using a 3 generation pedigree.

Results and discussion

The mean mortality rate in viable calves from birth to weaning was 8.3%, and was not significantly different across breeds. Logistic regression showed that calves born in the 38 – 40kg birth weight category had the lowest mortality rate (3.6%), but that calves born at 28kg or below had a significantly higher incidence of mortality (18%) compared to those born above this weight (7%). Table 1 presents the raw mean and standard deviation for BWT28, as well as variances and heritability for the trait. These show that selection could be applied to reduce the incidence of critically low birth weight in tropically adapted beef genotypes. Such a strategy may produce unfavorable correlated responses which increase average BWT and the incidence of critically high BWT. It is proposed, therefore, that the opportunity to analyze birth weight applying a threshold model, which would identify as undesirable BWT which were beyond a critically low or high level, be investigated in the genetic evaluation for tropical breeds.

Table 1. Raw means (Mean) and standard deviation (s.d.) for a binary trait identifying calves which were born below 28kg (1) or not (0), with additive (σ_a^2) and phenotypic variances (σ_p^2), and resultant heritability (h^2) in Brahman and Tropical Composite, estimated on the underlying scale.

Genotype	Mean	s.d.	σ_a^2	σ_p^2	h^2
Brahman	0.20	0.40	0.99	3.54	0.28
Tropical Composite	0.16	0.34	1.02	3.54	0.29

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364 Observations of tail rot in a Northern Territory breeder herd

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Introduction

Tail rot is a condition frequently observed in cattle in northern Australia where part of the tail rots away, resulting in a shorter 'stubby' tail. While the exact cause is not known, a widely held belief is that it is a result of injury to the tail, such as: a dislocation, break or other trauma. It is thought that an injury to the tail may disrupt blood flow to and from the tissue below, causing blood clots to form which can further disrupt circulation. The clotted blood then causes necrosis of the tissues, resulting in gangrene and eventually the tail breaks away (Fordyce *et al.* 2009). It has also been suggested that infections that impact circulation, such as BVD may also be a contributing factor. While tail rot is common in breeder herds, there has been no published data detailing its prevalence.

Methods

The prevalence of tail rot was recorded for- 294 Brahman (Bra) and 247 F1 Senepol x Brahman (F1Sen) mixed-age cows that co-grazed two adjacent native pastured paddocks on Manbulloo Station, NT in September 2018. Cows were managed as two mobs, with 7 and 8 year old cows of both breeds in one paddock and 5 and 6 year old cows of both breeds in the other. Data was analysed using negative binomial regression model.

Results and Conclusions

The overall prevalence of tail rot observed was 3.6% (1.4-5.8%, CI 95%). Even though the prevalence was over two-fold higher in Bra (4.7%) when compared to F1Sen (2.1%), this difference was not significant ($P=0.14$; Table 1). The prevalence of tail rot was positively associated with age ($P=0.01$), with the prevalence of tail rot generally increasing by 1.9% per year. This association was independent of breed ($P=0.15$).

Table 1. Prevalence of tail rot in Bra and F1Sen cows in September 2018

Age (yrs)	Bra		F1Sen		Combined Breed	
	Number of cows	Prevalence Tail rot	Number of cows	Prevalence Tail rot	Number of cows	Prevalence Tail rot
5	81	2.5%	80	0%	161	1.2%
6	74	2.7%	76	1.3%	150	2.0%
7	103	7.8%	61	1.6%	164	5.5%
8	36	5.6%	30	10.0%	66	7.6%
TOTAL	294	4.7%	247	2.1%	541	3.6%

These findings highlight that age is an important risk factor of tail rot and its effect should be considered in the development of future research studies.

Reference

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365 Supplementary feeding to improve Meat Standards Australia compliance doesn't pay?

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Introduction

Supplementary feeding of cattle in central Australia has the potential to lift production by improving growth rates at critical times. This can help cattle to reach production targets, and provide producers with opportunities to reliably access premium beef market prices. Meat Standards Australia (MSA) recommend a 3-week co-grazing period prior to trucking to reduce the effects of social stress from boxing of different paddock mobs. This project aimed to supplementary feed steers with a high protein and energy feed (Lucerne Hay) during the 3-week co-grazing period to maximise steer muscle glycogen levels prior to trucking, and improve meat pH and MSA compliance.

Methods

In February 2019, 134 steers (average: 30 month of age; 550 kg liveweight) on the Old Man Plains Research Station, Alice Springs, NT, were co-grazed for 41 days in an ungrazed 26 km² paddock dominated by cured Buffel grass (*Cenchrus ciliaris*) (9-31% moisture). Lick blocks (URAMOL® 30% Urea) were continually available to all steers. The steers were drafted into two groups with a Tru Test Remote WOW/auto-drafter at the watering point. One steer group (Hay) were supplemented for the final 22 days with lucerne hay (3.8 kg/head.day; crude protein (CP) 21%; dry matter (DM) digestibility (DMD) 66%; metabolisable energy (ME) 9.7 MJ/kg DM; cost ~\$1/kg) and pangola grass hay (*ad lib*; CP 4%; DMD 43%; ME 5.7 MJ/kg DM). The second group (No Hay) had no access to supplementary hay. Both steer groups were trucked direct to slaughter (1700 km) for MSA grading.

Results

Table 1. Mean steer performance (growth rate calculated over final 22 days).

Steer group	n	Starting/Finished liveweight	Growth per day	Carcase weight	Price per kg
Hay	68	531/551 kg	0.91 kg	283 kg	\$5.17
No Hay	66	539/557 kg	0.82 kg	282 kg	\$5.13

Table 2. MSA compliance level for each steer group (mean in brackets; *median).

Steer group	MSA compliance / Index	Meat pH (<5.71)	Meat colour target (<4)	Rib fat cold (>2mm)	P8 fat (>4mm)	Fat colour target (<4)
Hay	90% (*56.33)	97% (5.55)	100% (2.19)	89% (4.71)	97% (9.72)	100% (1.5)
No Hay	79% (*55.72)	94% (5.54)	95% (2.21)	83% (4.29)	98% (9.59)	96% (1.9)

Discussion and conclusion

High MSA compliance (including low meat pH) of 30-month-old steers grazing a Buffel grass dominant pasture is possible in central Australia. The relatively good compliance of all steers meant that although supplementary feeding with Hay three weeks prior to trucking improved the MSA compliance by 11%, it was not cost-effective. This highlights the comparatively good quality of rangeland pastures in central Australia. With good management of the stocking rate, it is possible for a breeding/finishing operation to achieve adequate compliance for premium beef markets without high protein and energy feed supplementation.

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369 Temporal changes in gastrointestinal microbiomes of beef cattle on feedlot placement

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Introduction

A majority of beef cattle are finished in feedlots after purchase. However, feedlot placement has also been found to adversely influence cattle health, predisposing them to many diseases including Bovine Respiratory Disease (BRD). BRD is an important feedlot disease causing significant economic losses in beef cattle. While the influence of feedlot transition on disease predisposition is known to be mechanistically complex and multifactorial, the host microbiome could play a key role. Accordingly, the current project aimed to characterise temporal changes in gastrointestinal microbiota of beef cattle upon feedlot placement.

Methods

Faecal samples from 30 cattle were sampled upon feedlot induction (day 0), and then repeat sampling was carried out on days 2, 7 and 14. Lung scores were obtained on the last day of sampling (day 14) and subsequently 15 samples were chosen based on consistency of faecal samples across all four days of sampling, and lung scores obtained on day 14. Total DNA extracted from these faecal samples were subjected to 16s rDNA sequencing to determine the relative abundance of microbial species.

Results

Results indicate that feedlot transition significantly impact gastrointestinal microbiome profiles, particularly around 2 days after feedlot placement. On day 2, the proportion of key groups of bacteria previously associated with gastrointestinal diseases, like proteobacteria and actinobacteria, were significantly affected.

Conclusions

Overall, results suggest that gastrointestinal microbiota are significantly impacted due to feedlot placement of beef cattle, and their role in contributing to feedlot associated disease predisposition, including BRD, warrants further investigation.

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