

# 2026



**CONFERENCE HANDBOOK**

**PROCEEDINGS OF THE NORTHERN BEEF RESEARCH  
UPDATE CONFERENCE**



**NORTHERN BEEF RESEARCH UPDATE CONFERENCE**

**10-13 MARCH 2026**

**VOCO BRISBANE CITY CENTRE, QLD**

**[www.nbruc.com.au](http://www.nbruc.com.au)**

**FROM RESEARCH TO RESULTS: DRIVING Paddock PERFORMANCE**

**Published by the North Australia Beef Research Council**

ROMA Q 4455 [secretariat@nabrc.com.au](mailto:secretariat@nabrc.com.au)

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Northern Beef Research Update Conference 2026 Organising Committee: Richard Cox, Paul Burke, Jackie Kyte, Nigel Tomkins, Tim Schatz, Dale Miller, Trevor Price, Jay Mohr-Bell, Tony Parker, Nigel Perkins, Gonzalo Martinez-Fernandez, Thomas Williams and Laney O'Neil.

# FROM RESEARCH TO RESULTS: DRIVING Paddock PERFORMANCE

## Foreword

It is a great pleasure to introduce these proceedings and, on behalf of NABRC, welcome you to the 2026 Northern Beef Research Update Conference (NBRUC). Whilst the Research dollars are more difficult than ever to find, the work that NABRC and our partners provide the Beef sector remains critically important in driving profitability, better land management outcomes and diversified opportunities for producers.

The NBRUC conference this time around the theme of the conference is Research to Results, Driving Paddock Performance. Having research that is a priority of producers will greatly assist with uptake and ultimately operational profitability. NBRUC is the key meeting place for these discussions, NABRC have prioritised getting more producers than ever along to the conference.

So, this meeting is a great opportunity to listen, reflect and learn, be inspired, create new relationships and expand social networks, among beef cattle producers, current and emerging researchers, advisors' governments and all key stakeholders, that underpin innovation and adoption. These are key elements aligned to NABRC's values and its mission to drive a focus on RD&A to support an innovative, proactive, profitable and sustainable northern beef industry.

On behalf of NABRC I thank the organising committee, under the leadership of Richard Cox, and the guidance of Laney O'Neil, the event coordinator, for a stimulating program. NABRC extends its sincere thanks to Dr Nigel Tomkins, who has led the development of the NBRUC 2026 conference program. Dr Tomkins' leadership, expertise and commitment have been instrumental in shaping a strong, relevant and high-quality program that reflects industry priorities.

We also extend our sincere thanks to the individuals from our northern beef RD&E community who served as abstract reviewers and copy editors. Their thoughtful comments, careful editing, and commitment to accuracy helped improve both the scholarly quality and readability of the abstracts included in these proceedings and contributed to delivering a robust conference program. We recognise that this process requires a considerable investment of time, and we greatly appreciate their generous contribution. Without their support, this publication would not have been possible.

Lastly and most importantly, thank you to all our sponsors who have made this event possible. Please enjoy the content and the social activities.

**Paul Burke**  
NABRC Chair

# PROGRAM

## TUESDAY 10 MARCH 2026

4.00pm – 6.00pm	<b>Conference registration</b> <i>Grand Chelsea Lobby</i>	
6.00pm – 8.00pm	<b>Welcome Reception</b> <i>Chelsea Lane</i>	Sponsored by 

## WEDNESDAY 11 MARCH 2026

6.15am for 6.30am start	<b>Meat &amp; Livestock Australia Beef Industry Breakfast</b> <i>The Grand Palms</i>	
7.30am	<b>Conference registration</b> <i>Grand Chelsea Lobby</i>	
8.30am – 9.00am	Arrival tea and coffee – <i>Grand Chelsea Lobby</i>	
<b>9.00am – 10.30am</b>	<b>Session 1 – Welcome to the 8th Northern Beef Research Update Conference</b>	<i>Grand Chelsea Ballroom</i> Chair: Paul Burke
	<b>Conference welcome and opening</b> <i>Paul Burke, NABRC Chair</i> <i>The Honourable Tony Perrett MP, Minister for Primary Industries, Queensland Government</i>	
	<b>Keynote presentation: Research to results – using data and technology</b> <i>Derek Bailey, Director of Research and Outreach, Deep Well Ranch (Arizona, USA)</i>	Sponsored by 
	<b>Keynote presentation: Lessons learnt – how the north can keep winning</b> <i>David Foote, DF Agrifood Advisory</i> Q&A	
10.30am – 11.00am	Morning tea – <i>Grand Chelsea Lobby</i>	
<b>11.00am – 12.30pm</b>	<b>Session 2 – Stretching the research dollar</b>	<i>Grand Chelsea Ballroom</i> Chair: Jayne Cuddihy
11.00am	<b>Framing the future of R&amp;D investment: The MLA strategic plan 2030</b> <i>Sarah Strachan – General Manager, Research Development and Adoption, Meat &amp; Livestock Australia</i>	Sponsored by 
11.20am	<b>Moving the dial for northern beef research in a cost price dilemma</b> <i>Ian McLean – Managing Director, Bush Agribusiness Pty Ltd</i> <i>Kieren McCosker – Senior Research Fellow, QAAFI, The University of Queensland</i> <i>Geoff Murrell – Pastoral Partners Australia</i>	
12.00pm	<b>Table talk: Does “leaner have to be meaner” for meaningful research to have impact for northern beef herds?</b> <i>Moderated by Jayne Cuddihy</i> <i>Industry and representatives for state agencies reflect on the cost of applied research and challenges in making budgets deliver meaningful outcomes that move the dial for northern beef production systems.</i>	

## WEDNESDAY 11 MARCH 2026

12.30pm – 1.30pm	Lunch – <i>Grand Chelsea Lobby</i>		
<b>1.30pm – 3.00pm</b>	<b>Session 3 – Concurrent sessions: Animal health, reproduction and herds on the move</b>		
<b>Session</b>	<b>3A – Ticked off: vaccines, vectors and disease detection</b>	<b>3B – Crush to cradle: optimising reproductive performance</b>	<b>3C – Environmental stewardship: pastures on the radar</b>
<b>Room</b>	Daintree	Topaz	Sundown
<b>Chair</b>	Johann Schröder	Greta Dunne	Dianne Mayberry
	<p>Paul Stewart – Remote surveillance for emergency animal disease using artificial intelligence (10)</p> <p>Lida Omaleki – Pasturella multocida and Bovine Respiratory Disease: What does the diversity of Lipopolysaccharide tell us? (10)</p> <p>Jess Morgan – Update on synthetic pyrethroid insecticide resistance in buffalo fly (10)</p> <p>Hannah Siddle – Safe guarding beef production with rapid chemical resistance tests in ticks (3)</p> <p>Guilherme Klafke – RaTexT® as a rapid field alternative to laboratory bioassays for detecting acaricide resistance in cattle ticks</p> <p>Tim Schatz – Assessing the effectiveness of a new type of insecticidal cattle ear tag (3)</p> <p>Zheto Zhang – Pilot trial of a whole-cell killed Bovine Genital Campylobacteriosis vaccine (3)</p> <p>Caity Kelly – The occurrence of vaccine injection site reactions in a northern beef herd (3)</p> <p>Harvey Santos – Efficacy and safety of an Australian whole-cell killed Trichomonas foetus vaccine in T. foetus naïve young bulls (3)</p> <p>James Copley – Using a test and cull strategy reduces Trichomoniasis prevalence in Northern Australia beef bulls (3)</p> <p>Mark Trotter – The case for on-animal sensors as a tool for endemic and exotic disease surveillance (3)</p> <p>Q&amp;A (if time permits)</p> <p>Sponsored by  <b>PARAWAY PASTORAL CO.</b></p>	<p>Elsie Vincent – Validation genomic breeding values for beef female fertility (10)</p> <p>Benjamin Wood – Incidence of Trichomonas foetus increases with bull age indicating culling for age may be a suitable control option (10)</p> <p>Ella Watkins – Pawsitive pregnancy: Investigating detection dogs for cattle pregnancy diagnosis (10)</p> <p>Antonio Reverter – Enhanced multi-breed genomic prediction for bull fertility using breed-adjusted genomic relationship matrices (10)</p> <p>Matt Wolcott – Genomic benchmarking in commercial beef herds to inform bull selection decisions in extensive, northern production systems (3)</p> <p>Mel Wooderson – Improving the fertility of a Brahman herd through the use of high fertility bulls in the Northern Territory (3)</p> <p>Piper Smith – Mooternal: Investigating relationships between maternal investment, calf loss and productivity in Northern Australia (3)</p> <p>Rebecca Burnham – ‘Beefing Up Genomics’ – A producer driven approach to reference populations (3)</p> <p>Samantha Rudd – Topical wound treatments targeting haemorrhage and infection in amputation dehorned calves (3)</p> <p>Kim Hubbard – The effect of lactation anoestrous of first-calf cows on weaning weight (3)</p> <p>Q&amp;A (if time permits)</p> <p>Sponsored by  <b>CPC</b></p>	<p>Robyn Cowley – Finding the Sweet Spot: Pasture utilisation that maintains land condition is the most profitable over the long term (10)</p> <p>Baisen Zhang – Seasonal pasture budgeting at property scale – a FORAGE online tool (prototype) for assessing stocking rates for Queensland grazing lands (10)</p> <p>Jason Barnetson – Mapping pasture quality: Using remote sensing to address Northern Australia’s fodder gap (10)</p> <p>Luis Woodrow – Adjusting the seasonal persistent green product for green grass signal (10)</p> <p>James Dougherty – Cottonseed supplementation of Rhodes grass hay improves growth of Brahman cross steers in the Northeast Kimberley (10)</p> <p>Georgia Anderson – What drives cattle landscape use in Central Australia? (3)</p> <p>Luis Prada e Silva/Tamara Freitas-Kirk – Bluetooth ear tags can help track supplement intake in grazing cattle (3)</p> <p>Gretel Bailey-Preston – FireGraze: Using strategic patch burning to influence cattle grazing behaviour and improve land condition (3)</p> <p>Q&amp;A (if time permits)</p>
3.00pm – 3.30pm	Afternoon tea – <i>Grand Chelsea Lobby</i>		

## WEDNESDAY 11 MARCH 2026

3.30pm – 4.30pm			
Session 4 – Concurrent sessions: Methane, practice change and the R&D legacy			
Session	4A - The “not the methane” session?	4B - Good projects, good results: delivering the R&D legacy for northern systems	4C - Drivers of practice change
Room	Daintree	Topaz	Sundown
Chair	Matt Callaghan	Simon Quigley	Kieren McCosker
	<p>Richard Heath - Zero Net Emissions from a thriving Australian agriculture sector (20)</p> <p>Melissah Dayman - From weaning to research ready: Enhancing Greenfeed Emissions Monitoring (GEM) unit interaction in extensive grazing systems (3)</p> <p>Melissa Matthews - Methane emissions from cattle grazing Desmanthus pastures on property (3)</p> <p>Hayley Norman - Advancing faecal NIRS for predicting intake and methane emissions from Northern cattle herds (3)</p> <p>Marina Fortes - Measuring methane emissions under grazing conditions in Brahman heifers (3)</p> <p>Diane Ouwerkerk - Discovering Northern Australia’s low methane feedbase potential (3)</p> <p>Lachlan Godson/Zac Geldof - Legume-enhanced pastures with fertiliser inputs improve productivity and reduce net GHG emissions in a Central Queensland beef system (3)</p> <p>Céline Chaléat - Controlled-release technology for methane mitigation in grazing beef cattle: 3-nitrooxypropanol (3-NOP) release profiles in water (3)</p> <p>Gonzalo Martinez-Fernandez - Use of Bovaer in drinking water for Northern Australian cattle (3)</p> <p>Cameron Whistler - Genomic prediction to select for lower methane production in purebred, crossbreed and composite cattle in northern Australia (3)</p> <p>Elaine Mitchell - Evidence for enhanced soil carbon and nitrogen stocks under time-controlled grazing in the Australian subtropics (3)</p> <p>Tien Chinh Nguyen - Biodiversity and carbon storage in a Corymbia hybrid silvopastoral system in northern Australia (3)</p> <p>Julia Waite - Wrap up and discussion</p>	<p>Steven Bray - Sixty-year experiments, hidden in the Mulga, informing today’s issues (10)</p> <p>Robyn Cowley - Why are woody plants increasing? The value of long term studies - lessons from a 30+ year burning experiment and 50+ year grazing exclosures (10)</p> <p>Stuart Buck - Sowing seeds of legume success in central Queensland (10)</p> <p>Gavin Peck - Old evaluation trials delivering a legacy of new persistent legume varieties (10)</p> <p>Mary Williams - Augmenting native pastures with legumes as a pathway to resilience and increased productivity in the Victoria River District of the NT (3)</p> <p>Michael Finey - Demonstrating the challenges of augmenting native pastures with legume cultivars on cracking clay soils in the Victoria River District (VRD), NT (3)</p> <p>Jaidyn Eastaughffe - Long-term dynamics of species composition in the Northern Territory Rangelands: a 50-year perspective (3)</p> <p>Juan Guerschman - Improved monitoring of pastoral landscape productivity and trends in the Rangelands (3)</p> <p>Bernie English - Legume production paddocks improve dry season diet quality and animal performance on fertile soils in north Queensland (3)</p> <p>Greta Dunne - Species proportion trends on the Richmond Downs post 2019 flood (3)</p>	<p>Harry Evans - Understanding herd performance requires clarity in classifications (10)</p> <p>Sampath Dissanayake - Unveiling the performance drivers of northern Australian beef systems: A time series analysis (1990-2022)(10)</p> <p>Kieren McCosker - Key drivers of profitability within north Australian beef breeding businesses (10)</p> <p>Sampath Dissanayake - Bioeconomic evaluation of prepartum nutritional supplementation in northern Australian beef production systems (10)</p> <p>Harry Milbank - Economic evaluation of establishing pasture legumes in the Brigalow Belt (10)</p> <p>Tim Schatz - Crops for Cattle - Increasing the efficiency of north Australian cattle production systems through strategies to improve dry season weight gain (3)</p> <p>Carrie-Ann Wilson - BeefVantage: Collaborative intelligence for better beef decisions (3)</p>

## WEDNESDAY 11 MARCH 2026

6.30pm – 10.30pm **Conference Dinner and NABRC Medals Awards Night**  
Grand Chelsea Ballroom

Sponsored by



## THURSDAY 12 MARCH 2026

7.30am **Conference registration**  
Grand Chelsea Lobby

7.30am – 8.00am Arrival tea and coffee - Grand Chelsea Lobby

**8.00am – 10.00am** **Session 5 – Plenary session: Industry led innovation, partnerships and extension** Grand Chelsea Ballroom Facilitated by Jean Kittson

8.00am **Capture, engage and keep valuable people**  
*Barb Bishop*

**Delivering outcomes for the Kimberley and Pilbara pastoral industry**  
*Bron Christensen*

**Campfire chat – the use of VR and AI technology in an Indigenous Peer to Peer learning group**  
*Ian Perkins*

**Driving adoption of innovation at scale through experiential learning**  
*Claire Mahony*

**Extension and adoption across the Gascoyne**  
*Krystie Bremer*

Q&A

9.00am **Producer Panel – Pilbara Voices: Rethinking Research from the Ground Up**  
*Sponsored by Pilbara Innovation Partnership*

Pilbara producers are reshaping how research happens across northern WA. This session brings together pastoralists to share what producer-led research looks like in practice – the opportunities, barriers, and lessons learned from working directly with scientists and funders. Facilitated by Dr Kelsey Pool (UWA), the panel will explore how producers identify research-able issues within their own stations and regions, what makes research relevant and scalable, and how stronger producer involvement can drive greater adoption and long-term impact across the rangelands.

10.00am – 11.00am Morning tea - Grand Chelsea Lobby

## THURSDAY 12 MARCH 2026

11.00am – 12.00pm			
Session 6 – Concurrent sessions: Decision tools, legumes and reproduction			
Session	6A - Decision tools & technology for improved management	6B - Legumes, trees, rangelands and carbon	6C - Improved reproduction and resilience
Room	Daintree	Topaz	Sundown
Chair	Dale Miller	Kendrick Cox	Hayley Norman
	<p>Ian Dunbar – Spatial survey to assess legume adoption in Queensland (3)</p> <p>Roger Sneath – Excel dry season pasture budget soon to be available on FutureBeef (3)</p> <p>Mehrnush Forutan – Genetic tools to support fertile and productive cattle (3)</p> <p>Tim Emery – Using smart collars to help keep an eye on your bull team 24/7 (3)</p> <p>Greg Campbell – Automated, remote detection of oestrus in grazing cattle using CERES TAG Sensors (3)</p> <p>Christie Pearson – Virtually fencing cattle onto new water points in Northern Australia (3)</p> <p>Stephen Wiedemann – Updating the life cycle carbon assessment of Australian livestock exports (3)</p> <p>Kate Holzapfel – Developing sustainable carrying capacities in the Victoria River District of the Northern Territory (3)</p> <p>Thomas Williams – Tracking reveals cattle group into spatial and social clusters, but performance does not differ between groups (3)</p> <p>Tony Cavallaro – Field prototype for oral sample collection in grazing ruminants (3)</p> <p>Grant Stone – The FORAGE system – the ‘track record’ (10)</p> <p>Kara-glenn Worth – Reducing barriers to agriculture technology adoption through innovation-readiness assessments (10)</p> <p>Mark Peart – Unlocking a new source income in livestock production: Literature Review (3)</p> <p>Sponsored by</p> 	<p>Jane Evans – Production potential of improved pastures on northwest Queensland Downs (3)</p> <p>Vanessa Macdonald – Spatial analysis of legume suitability in Queensland (3)</p> <p>Saranika Talukder – In vitro total gas production and nutritional evaluation of tropical legumes (3)</p> <p>Ajay Augustin – Evaluating seed yields of Stylosanthes seabrana and Stylosanthes scabra in southern Queensland compared to northern Queensland (3)</p> <p>Kendrick Cox – Cultivated strips fast-track legume establishment in red basalt woodland (3)</p> <p>Kerry Goodwin – Silvopastoral establishment provides insight into animal production (3)</p> <p>Joe O'Reagain – Vegetative propagation of putatively sterile Leucaena genotypes (3)</p> <p>Stuart Buck – Feed availability in mature leucaena paddocks (3)</p> <p>Kate McCullough – Urea boosts biomass but reduces litter cover in gully remediation (3)</p> <p>Gavin Peck – New stylo varieties for frosty locations (3)</p> <p>Dana Walkington – Testing pasture establishment techniques in the Desert Uplands (3)</p> <p>Elaine Mitchell – Soil carbon sequestration under tropical perennial legume Desmanthus in northern Australian grasslands (10)</p> <p>Nahuel Pachas – Steak n Wood project: Silvopastoral systems research in Queensland and northern New South Wales (10)</p> <p>Sponsored by</p> 	<p>Dana Walkington – On-property research and strong relationships result in practice change that increases land condition and carrying capacity in Western Queensland (10)</p> <p>Kirsty Moore – Managing myostatin mutations (double muscling) in northern Australian tropically adapted beef breeds (10)</p> <p>Elizabeth Ross – Solving the discordance between poll genotypes and phenotypes in Northern Beef Cattle (10)</p> <p>Mark Peart – Water-based vs. traditional supplementation in cattle: A case study (3)</p> <p>Tim Schatz – Easy P – evaluation of a Phosphorus supplementation strategy that is easy to implement in areas that are difficult to access during the wet season (3)</p> <p>Janna Sim – Breedcow Lite – streamlined for dynamic use by graziers and advisors (3)</p> <p>Luis Prada e Silva – Pre-calving nutrition improves reproductive efficiency in northern beef herds (3)</p> <p>Niilo Gobius – Breedcow+ provides northern producers with options to improve gross margins and improve land condition (3)</p> <p>Grete Bailey-Preston – Observations of early calving history on a cow's third and fourth mating outcomes in a high fertility Brahman herd (3)</p>

## THURSDAY 12 MARCH 2026

12.00pm – 1.00pm			
Session 7 – Concurrent sessions: Tools and tech, building capacity and managing for improved productivity			
Session	7A – Decision tools & technology for improved management	7B – Extension, building capacity & regional capability	7C – Managing stressors for improved productivity and sustainability
Room	Daintree	Topaz	Sundown
Chair	Anita Chang	Stacey Holzapfel	Tony Parker
	<p>Christie Warburton – How many SNPs are required to perform multi-breed genomic predictions in Australian cattle populations? (10)</p> <p>John Carter – Seasonal forecasting: A simple analysis of various statistical and weather model forecasts for Queensland (10)</p> <p>Dianne Mayberry – National Climate Risk Assessment – key messages for the Australian northern beef herd (10)</p> <p>Fiona McCartney – Understanding FORAGE report user experience to improve its usefulness for grazing land management decision-making (10)</p> <p>Ana Carla Leite De Almeida – Biodiversity into focus: ESG metrics and reporting in the beef sector (10)</p> <p>Laercio Porto-Neto – Combining reproductive and genomic biotechnologies to further improve beef production (10)</p>	<p>Liz Moss – Pilbara Extension Network: Producer-led research and extension in the Pilbara beef industry (10)</p> <p>Beth Penrose – Building research capacity and capability in the north: the new Research Institute for northern agriculture at Charles Darwin University (10)</p> <p>Ted Callanan – Ramping up extension delivery as pasture dieback spreads south (10)</p> <p>Nicole Sallur – FutureBeef—widely valued, driving practice change (3)</p> <p>Kylie Hopkins – Queensland pastures e-newsletter increases beef industry engagement (3)</p> <p>Marcia Smith – The value of knowledge diversity - what if I am wrong? (3)</p> <p>Natalie Hughes – Strengthening the beef industry’s drought, business, and financial resilience through the Advancing Beef Leaders program (3)</p> <p>Stacey Holzapfel – Research to reality: investigating barriers to on-station practice change (3)</p> <p>Ryan Honor – The Northern Breeding Business program – Peer to peer learning fostering the adoption of improved cattle grazing business management practices and technologies in the Fitzroy River catchment (3)</p> <p>Greta Dunne – Producer-focused demonstration site increases engagement in north west Queensland (3)</p> <p>Megan Willis – Developing a formal staff induction and mentoring program for the Department of Primary Industries Extensive Livestock Systems RD&amp;E work group (3)</p>	<p>Ben Allen – Novel animal welfare assessment tools for mass euthanasia of intensive livestock (3)</p> <p>Michele Tree – Impact of long-distance transport on cross-bred Bos indicus beef cows (3)</p> <p>Harriet Dunne – Livestock refuge mounds in northwest Queensland (3)</p> <p>Samantha Rudd – Evaluation of post-dehorning wound treatments in extensive Australian beef systems to improve performance and wound healing (3)</p> <p>Samantha Rudd – Evaluating novel and existing wound treatments for cattle (3)</p> <p>Samantha Rudd – Attitudes and practice on pain relief for dehorning cattle in Northern Australia (3)</p> <p>Angela Lees – Influence of heat tolerance classification on rumen temperature regulation (10)</p> <p>Vicki Mayne – Thriving through change: Integrating climate science into livestock thermal stress management in northern Australia (10)</p> <p>Jill Fernandes – Is there a return on cattle welfare investment? (10)</p> <p>Vitor Mercadante – Unravelling the reproductive, hormonal and metabolic differences between Bos indicus and Bos taurus cows while under nutritional restriction (10)</p>
1.00pm – 2.00pm			
Lunch – <i>Grand Chelsea Lobby</i>			

## THURSDAY 12 MARCH 2026

<b>2.00pm – 3.15pm</b>	<b>Session 8 – Plenary session: Getting results &amp; adoption</b>	<i>Grand Chelsea Ballroom</i>	Facilitated by Kylie Hopkins
	<b>Adoption: The journey that delivers industry impact</b> Sally Leigo (15) <b>Typology of Australian beef producers and the sustainability challenges</b> Bradd Witt (10) <b>The role of CRC in translating results to adoption</b> Richard Heath (10) <b>Catchment collaboration – facilitating NRM groups to succeed</b> Amanda Roughan (10) Panel session Q&A		
3.15pm – 3.45pm	Afternoon tea – <i>Grand Chelsea Lobby</i>		
<b>3.45pm – 4.30pm</b>	<b>Session 9 – Closing plenary session</b>	<i>Grand Chelsea Ballroom</i>	Facilitated by Tim Schatz
	<b>Research, results &amp; reflection – why the 3 Rs still matter</b> Wayne Hall <b>Eating that elephant in my paddock</b> Jayne Cuddihy <b>Concluding remarks and farewells from NBRUC2026</b> Paul Burke		
<b>5.30pm – 8.30pm</b>	<b>Closing drinks – Northern Beef Olympics: After-Hours</b> Limber up for Brisbane 2032 and enjoy a podium-worthy wind-down. Come solo or rally a team – and show us your best Olympic-themed outfits! <i>Chelsea Lane</i>		



## FRIDAY 13 MARCH 2026

7.10am – 5.30pm

### **FIELD TRIP**

(Optional and ticketed)

Please meet in front of voco reception (85-87 North Quay) by 7.10am sharp.

Depart voco Brisbane City Centre.

#### **Site visit to Aroona Station**

A Queensland Trust for Nature property – balancing beef and biodiversity including morning tea and lunch.

Site tours across four themes:

- Led by Dr Liz O'Brien – reality of engaging in environmental markets;
- Dr John Rochecouste – nature dependencies and reporting;
- Dr Nahuel Pachas – Steaks and wood, Silvo pastural systems;
- Harrison Mavin – Farmbot monitoring solutions.

QTFN's Aroona Station is a magnificent 2,000-hectare property in the significant wildlife corridor of the Little Liverpool Range about 55km Southwest of Ipswich. A working cattle property for over 50 years with large areas of diverse native vegetation that supports varied and viable populations of conservation-significant wildlife, Aroona Station showcases how nature conservation, best practice land management and sustainable beef production can co-exist in harmony. You will visit four 'stations' on the property and learn more about the realities of engaging in environmental markets, nature dependencies and reporting, steak and wood – silvo pastural systems and see Farmbot's monitoring systems in action.

#### **Site visit to Queensland Animal Science Precinct, The University of Queensland, Gatton**

For a tour within the non-containment area.

Led by Milou Dekkers, the theme for the visit will be 'Research Capabilities'.

You will visit three 'stations' and hear from students and researchers as they showcase equipment and its use in research.

The Queensland Animal Science Precinct (QASP) is a world-class facility at The University of Queensland's Gatton campus focused on animal industries.

This is a major hub for agricultural research and development in Queensland, fostering collaboration between scientists and industry to achieve practical outcomes and strengthen the state's agricultural sector.

Refreshments served at UQ, Gatton prior to departure.

Return to voco Brisbane City Centre.

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## Research to results – using data and technology

Derek W. Bailey<sup>A,B,D,E</sup>, Ly Ly Trieu<sup>B</sup>, Huiping Cao<sup>B</sup>, Tran Cao Son<sup>B</sup>, Jiefei Liu<sup>B</sup>, Colin T. Tobin<sup>C</sup>, Justin Macor<sup>D</sup>, Mark G. Trotter<sup>D</sup>

<sup>A</sup> Deep Well Ranch, Prescott, AZ 86304 USA; <sup>B</sup> New Mexico State University, Las Cruces, NM 88001 USA; <sup>C</sup> Kansas State University, Manhattan, KS 66506 USA; <sup>D</sup> CQ University, Rockhampton, Qld 4701

### Introduction

Monitoring cattle on rangelands is time-consuming and often impractical. Real-time tracking and on-animal sensors are now commercially available. Global positioning system (GPS) receivers included on collars, ear tags and virtual fence systems can provide cattle locations to producers, while accelerometers can remotely monitor cattle activity and behaviours. These devices provide data streams that must be summarized, analysed and evaluated to provide managers useful information to help make decisions. Traditional statistical techniques can be cumbersome for analysing on-animal sensor data streams. Artificial intelligence technologies such as machine learning and deep pattern mining can be used to classify behaviours, evaluate patterns and detect welfare concerns using on-animal sensor and tracking data.

### Machine Learning

Supervised machine learning has been used to classify cattle behaviours from accelerometer and tracking data, often with the goal of creating activity budgets. This technique has also been used successfully to identify rumination, parturition and potentially dystocia. Although its application has been very successful, supervised machine learning requires extensive observations to train the algorithms, which is labour intensive. In contrast, unsupervised machine learning does not require observations for training. Our initial research suggests that cattle activity can be classified from tracking data without training observations using time series segmentation algorithms followed by cluster analyses.

### Pattern Mining

Behavioural patterns of livestock often change as animals become ill. Identifying pattern changes using traditional statistics can be difficult. Using accelerometer data obtained from two studies in Queensland, two approaches (cosine similarity and deviation from previous behaviour patterns) were applied to autonomously detect decreases in activity associated with cattle becoming ill with bovine ephemeral fever (BEF). Cattle activity (measured as movement variation) during the morning (0700-0900) and evening (1600-1900) grazing bouts was distinctly lower during the onset and duration of BEF. Two of 8 monitored heifers and 4 of 17 monitored cows were diagnosed with BEF using blood tests. The deviation algorithm detected a distinct decrease in activity during grazing bouts without false positives when cattle became ill with BEF. These case studies showed the potential of pattern mining to detect illness, sometimes before it was apparent to human observers.

Anecdotal observations have suggested that consecutive days of hot weather (heat waves) can adversely affect cattle behaviour to greater degree than a single hot day. Few, if any, research studies have evaluated the impact of heat waves on cattle grazing rangelands. Data mining was used to evaluate sequential patterns between cattle behaviour and thermal heat index using tracking data recorded at 10-minute intervals at Deep Well Ranch in Arizona during 2019 and 2021. Movement rate (meters/minute), activity (%) and distance from water were calculated during typical grazing periods (0500-0800 and 1700-2000) and the daylight period (0500-2000). An unsupervised co-occurrence map sequential pattern mining algorithm evaluated movement rates, activity and distance from water during grazing and daylight periods. However, patterns were only identified between behaviour changes and consecutive days of hot weather for movement rate during grazing periods. In 2019, cattle moved an average of 3.9 and 4.4 meters/minute slower during grazing periods after 3 and 4 consecutive days of hot weather, respectively, compared to previous rates. In 2021, the algorithm successfully detected that cattle moved 3.18 and 3.23 meters/minute slower during grazing periods

after 2 and 3 days of consecutive hot days, respectively, compared to previous periods. The decrease in movement rate following 2 to 4 consecutive hot days may reflect a decrease in grazing intensity and possibly reduced forage consumption, similar to observed decreases in feed intake of feedlot cattle during hot periods. Although, we do not know the actual physiological impacts on the cattle during hot periods in this study, pattern mining appears to be a useful tool for studying the effects of heat waves on livestock.

### **Discussion and conclusion**

Artificial intelligence technologies can help scientists evaluate behavioural patterns of cattle grazing rangelands. More importantly for livestock producers, machine learning and pattern mining have great potential to identify changes in behavioural patterns and help detect illness, concerns with heat stress and possibly other welfare concerns such as dystocia or poisoning of cattle grazing rangelands. However, the cost of cattle tracking devices and on-animal sensors limits their application in commercial cattle operations. Placement of sensors on a sample of the mob and using a sentinel animal approach might allow remote monitoring of cattle welfare and productivity at a much lower cost than placing devices on all animals.

<sup>E</sup> Corresponding author: [dwbailey@jamesfamilytrust.com](mailto:dwbailey@jamesfamilytrust.com)

# Lessons learnt - how the north can keep winning

David Foote <sup>A</sup>

DF Agrifood Advisory, Sandy Creek QLD 4515

## Introduction

Carrying approximately 65% of Australia's beef herd and generating almost \$4 billion pa in farm gate return – the northern beef industry plays a vital economic, social and border security role for Australia as a whole. The importance of this sector is indicative of the significant investment in R&D over many years to improve production efficiencies and has identified some key takeouts driving producer adoption.

A summary of the 2023 NABRUC proceedings highlighted six key areas of work which would generate opportunities for improved productivity and profitability across the northern beef sector:

- Profit follows pasture condition
- Anticipate climate risk early and adjust before production is lost
- Adopt technology to solve problems, not to collect data
- The cheapest production gains come from better breeders, not more inputs
- Sustainability is not a cost—it's a competitive advantage
- Great systems fail without capable people to run them

## Has the rubber hit the road?

Since 2023 learnings from programs supported by Meat & Livestock Australia (MLA) using levy and MLA Donor Company funds (MDC), namely CashCow and Northern Breeding Business (NB2) have demonstrated through adoption and practice change that:

- The biggest gains in northern beef businesses are coming from doing the basics better, more consistently
- Adopting proven breeder management are lifting weaning rates by 10–20%, worth hundreds of thousands of dollars per year in medium-to-large herds
- Better nutrition and breeder condition are cutting calf losses by half or more
- Managing pasture for the long term — not pushing stocking rates — is delivering higher profits and better drought outcomes
- Many businesses are running 20–30% more cattle effectively through better grazing distribution and water placement
- Simple nutrition fixes, especially phosphorus where needed, remains one of the highest return-on-investment management options available
- Technology works best when it helps make decisions, not just collect data

## ***Breeder performance is the biggest lever we can pull in extensive grazing systems.***

- Every 1% lift in weaning rate is worth around \$8–12 per cow per year
- A 10% improvement delivers \$80–120 per cow annually
- The key change since 2023 hasn't been new science, but greater confidence to act on what's already proven.

## **Pasture, grazing and managing climate risk**

Northern beef producers have increasingly moved toward flexible stocking rates, adjusting numbers earlier in response to seasonal conditions rather than waiting until feed is gone. This practice change has resulted in prioritising pasture recovery after rain and has seen management of extensive operations more willing to carry feed forward as a form of insurance in the face of climate uncertainty.

These systems reduce stress and cost during drought, avoiding forced destocking and expensive recovery.

***Nutrition – still one of the highest ROI***

Producers adopting phosphorus supplementation where needed continue to see:

- A five to 15% increase in pregnancy rates
- Better breeder condition
- Improved cow survival and lifetime productivity

***Technology that actually helps run the business***

The adoption of remote water monitoring is no longer novel and has continued to be adopted across northern systems driven by labour pressure, scale and risk. With the adoption of this technology alone producers generally report:

- 30–50% reductions in time spent checking waters
- Fewer emergency situations
- Improved confidence around animal welfare and compliance

Walk-over weighing technologies are also commercially available and have matured as a management tool which can be used to:

- Identify underperforming breeders
- Improve culling decisions
- Fine-tune nutrition

***Productivity, profitability and sustainability***

Doing the right things for productivity is also delivering sustainability benefits. Better breeder efficiency, improved pasture condition and risk-based grazing all increase kilograms of beef produced per hectare and per cow, which effectively reduces emissions intensity for the red meat supply chain.

**Conclusion: a take home message**

From a northern beef producer perspective, what's been adopted since 2023 is not about chasing the next new idea. The extent of adoption has been about doubling down on proven principles, namely:

- Lift weaning rates and cut calf loss
- Manage pasture for the long term
- Use nutrition where it pays
- Adopt technology only when it improves decisions

The evidence suggests that continued success in northern beef systems will come from embedding these principles deeper, not from reinventing them. For producers, the key point is that these gains are being delivered through better business performance, not by cutting production. For researchers, the strongest industry outcomes since 2023 have come from deeper adoption of proven principles that are practical, system-based, and designed with adoption in mind from the outset.

<sup>A</sup> Corresponding author: David@david-foote.com.au

# Finding the ‘Sweet Spot’: Retrospective analyses of pasture utilisation effects on female reproductive performance

KD McCosker<sup>A,G</sup>, RA Cowley<sup>B</sup>, M Wooderson<sup>B</sup>, G Whish<sup>C</sup>, C Materne<sup>B</sup>, D Smith<sup>C</sup>, G Fordyce<sup>D</sup>, D Mayer<sup>C</sup>, C Holloway<sup>C</sup>, B Wirf<sup>B</sup>, C Pettit<sup>B</sup>, T Oxley<sup>E</sup> and J Carter<sup>F</sup>

<sup>A</sup> The University of Queensland; <sup>B</sup> NT Department of Agriculture and Fisheries; <sup>C</sup> Department of Primary Industries, Queensland; <sup>D</sup> GALF; <sup>E</sup> Upriver NT Pty Ltd; <sup>F</sup> Department of Environment, Science and Innovation, Queensland

## Introduction

A trade-off exists between optimising breeder herd productivity per unit area through higher stocking rates and maintaining land condition. Despite total herd productivity improvements with increasing stocking rate, individual animal performance is often suppressed (O’Reagain *et al.*, 2011). The relationship between grazing pressure and animal performance has often used non-breeding cattle, leaving the direct effects on breeder herds relatively not quantified. The Sweet Spot project aimed to address this gap by identifying and collating breeder herd datasets from commercial and research stations across Northern Australia and analysing it to quantify the direct effects of pasture utilisation on key reproductive outcomes, including annual pregnancy rate, pregnancy within four months of calving, and foetal and calf loss. This paper reports the results of these analyses.

## Results

The final multilevel logistic regression models identified several significant and near-significant predictors of reproductive performance. Pasture utilisation was consistently associated with reduced performance for all reproductive measures. Animal age class was a significant predictor for all outcomes, while annual lactation status and body condition score were associated with foetal and calf loss. *Bos indicus* content influenced pregnancy, pregnancy within four months, and weaning percentage, whereas region was associated with calf loss. Several time-specific pasture factors were also found to be important determinants: pasture growth during the previous calving period influenced annual pregnancy; proportion of green pasture in the three months surrounding expected calving affected pregnancy within four months; and estimated pasture nitrogen in the preceding year, along with early dry-season (April–June) pasture growth, was positively associated with weaning percentage. Mating system was associated with pregnancy within four months. Notably, measures of heat load at the expected month of calving were not significant determinants.

## Discussion and conclusion

This study provides strong evidence that pasture management, nutritional availability and herd management practices are key determinants of reproductive performance in Northern Australian beef herds, particularly at key periods within the production cycle such as calving. High relative pasture utilisation consistently reduced individual reproductive outcomes. Access to high-quality pasture in the months surrounding calving and adequate pasture during the early dry season, showed additive positive benefits for increasing pregnancy and weaning success. These findings highlight the importance of integrating pasture management, nutritional support, and targeted reproductive strategies to optimise herd productivity and ecological sustainability in northern beef systems.

## Acknowledgment

This study was funded by Meat & Livestock Australia as B.GBP.0029 - The Sweet Spot project.

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<sup>G</sup> Corresponding author: k.mccosker@uq.edu.au

# Remote surveillance for emergency animal disease using artificial intelligence

Paul Stewart<sup>A,D</sup>, Jerome Leray<sup>B</sup>, Kat Bidstrup<sup>C</sup>, Tim Gentle<sup>C</sup>

<sup>A</sup> Queensland Department of Primary Industries, Toowoomba, Qld 4350; <sup>B</sup> InFarm Pty Ltd, Goondiwindi, Qld 4390; <sup>C</sup> Think Digital Studios Pty Ltd, Belair, SA 5052

## Introduction

A Department of Primary Industries (DPI) collaboration with technology companies Infarm and ThinkDigital has developed a remote surveillance system and mobile application that uses artificial intelligence (AI) to help producers identify signs of emergency animal diseases lumpy skin (LSD) and foot and mouth (FMD), together with endemic issues such as ticks and buffalo fly. The national economic impact of an LSD incursion is estimated at \$7.4 billion in the first year (DAFF 2023) and a multi-state outbreak of FMD could cost up to \$80 billion (ABARES 2022). Buffalo fly and cattle tick are estimated to cost the cattle industry \$304.6 million annually in lost production and control costs (Shephard *et al* 2022).

## Methods

Implementation of the remote surveillance system consisted of fixed camera nodes and a mobile app, with each node containing cameras, an edge computing device, autonomous power and connectivity. The node software incorporates the AI model, allowing integration into the cloud platform and reporting. The remote surveillance nodes were deployed at DPI's Brian Pastures Research Facility and captured video of cattle for a period of 18 months. Each night, video files were downloaded from the device and annotated as part of the AI model training. A producer interface was developed for the remote nodes and includes an alert system.

AI model training used image datasets collected from Australian (buffalo fly and ticks) and offshore (LSD and FMD) sources. A veterinarian was employed in Indonesia to gather images for the exotic model training. Images were annotated to identify signs of the targeted diseases and then used by the AI model for training. Once the models were trained, they were loaded into both the mobile app and remote node platforms for testing and function. The mobile app uses AI to identify suspicious signs on cattle from images taken by a user's phone and provides preliminary results without connectivity. Higher confidence results are provided when images are uploaded to a cloud platform when connectivity allows. The remote node hardware can operate the AI models without connectivity and only send a small amount of data to alert the producer.

## Discussion and conclusion

The mobile app and surveillance nodes can detect and alert suspicious signs that warrant further inspection by the producer. Any data collected by the platform is controlled by the producer and can be shared with a veterinarian for differential diagnosis if deemed necessary. These tools do not provide a diagnosis using AI, they can only identify the signs of disease. During the training of the AI models used, 205,000 annotations were made in the datasets, providing a high level of confidence of positive identification, however work will continue to further improve the models by collecting more positive images of each disease. A key advantage of these tools is that they provide a robust platform which can adapt to any new threat of disease. In the future, this project will focus on expanding the endemic disease and production issues that it can detect providing direct benefits to the producer while helping protect the industry and market access by performing biosecurity surveillance.

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<sup>D</sup> Corresponding author: paul.stewart@dpi.qld.gov.au

# ***Pasteurella multocida* and Bovine Respiratory Disease: what does the diversity of Lipopolysaccharide tell us?**

Lida Omaleki<sup>A</sup>, Jennifer Hosmer<sup>A</sup>, Valentine Murigneux<sup>B</sup>, Julian Zaugg<sup>B,C</sup>, Timothy J. Mahony<sup>A</sup>, Conny Turni<sup>A</sup>

<sup>A</sup> Queensland Alliance for Agriculture and Food Innovation, The University of Queensland; <sup>B</sup> Data Science Collaborative Research Platform, The University of Queensland; <sup>C</sup> Australian Centre for Ecogenomics, The University of Queensland

## **Introduction**

Bovine Respiratory Disease (BRD) significantly impacts feedlot cattle, with *Pasteurella multocida* being a major bacterial agent. Killed whole cell vaccines offer protection cattle against this disease (1). However, killed *P. multocida* vaccines protect only against field strains with same—or very similar—outer coat, which is mainly made up of lipopolysaccharide (LPS) (2). *P. multocida* exhibits nine outer LPS genetic loci (L1 to L9) representing 16 Heddleston serovars, however, the structural diversity of LPS extends beyond these, complicating vaccine design. Using whole genome sequencing (WGS), we curated LPS subtype data within the nine LPS types including inactivating mutations and analysed isolates from an Australian feedlot to assess implications for autogenous vaccine efficacy.

## **Methods**

During a seven-week period, 94 BRD-affected feedlot cattle were sampled, yielding 49 *P. multocida* isolates. LPS types of the isolates were identified using a multiplex LPS PCR, and DNA fingerprinting was performed. Short read WGS was performed, and the sequencing data were analysed using our LPS typing and subtyping workflow ([https://github.com/vmurigneu/LPS\\_typing\\_Illumina](https://github.com/vmurigneu/LPS_typing_Illumina)). Further to that, the sequencing data from other Australian studies were obtained from public databases, and their LPS genetic regions were analysed.

## **Results**

Diversity was observed in the DNA fingerprints of the isolates. The sequenced isolates belonged to either sequence type (ST) 79 or 394. All isolates had the LPS type L3, albeit with sequence diversity. Some isolates carried a frameshift mutation in one of the glycosyltransferase genes called *natB*, which would result in producing a semi-truncated LPS outer structure compared to those that did not carry this mutation. The analysis of the isolates from public databases is currently ongoing.

## **Discussion and conclusion**

Our genomics results demonstrated that *P. multocida* isolates circulating within a single cattle feedlot, and belonging to the same ST, can carry different alleles of glycosyltransferase genes, leading to the production of different outer structures. This is the first genomic-based workflow to aid industry in choosing isolates to include in killed vaccines while accounting for outer coat variations. The typing tool will be offered as a user-pay service for industry stakeholders and will also be made available on Galaxy Australia.

## **Acknowledgment**

This work was a part of Advanced Queensland Industry Research Fellowship with Scolexia Animal and Avian Health as the industry partner. Feedlot sample collection was supported through Meat and Livestock Australia grant (P.PSH.0874) with matching funds by the Australian Government.

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<sup>C</sup> Corresponding author: l.omal eki@uq.edu.au

# Update on synthetic pyrethroid insecticide resistance in buffalo fly

Jess A. T. Morgan<sup>AB</sup>, G.W. Brown<sup>A</sup>, E.V. Fowler<sup>A</sup>, S. Jarrett<sup>A</sup>, M.E. Vance<sup>A</sup> and B. Zhang<sup>A</sup>

<sup>A</sup> Department of Primary Industries, EcoSciences Precinct, 41 Boggo Rd, Dutton Park, Queensland, 4102

## Introduction

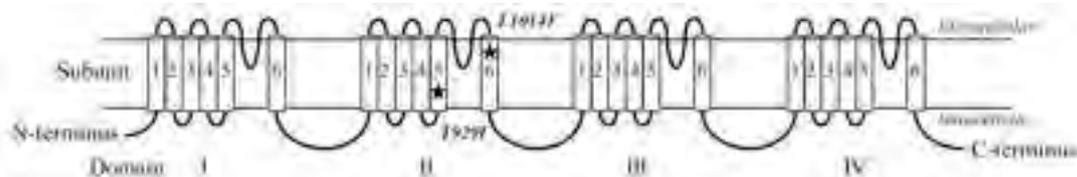
Buffalo flies, *Haematobia irritans exigua*, are ranked as the number one economic pest of cattle in Australia costing the cattle industry \$111.7M p.a. in production losses, and control measures contributing an additional \$58.6M p.a. (Shephard *et al.*, 2022). Elevated resistance to synthetic pyrethroids in Queensland buffalo fly populations led to this study to investigate if new voltage gated sodium channel (VGSC) mutations might be involved.

## Methods

Field collected buffalo flies were screened using chemical bioassays (Farnsworth 1997) to determine their resistance to  $\alpha$ -cypermethrin and deltamethrin. Flies were categorised as Susceptible (dead after 2 hours at cypermethrin concentration 3.4  $\mu\text{g}/\text{cm}^2$ ; dead at deltamethrin concentration 0.20  $\mu\text{g}/\text{cm}^2$ ) or Resistant (alive after 20 hours at cypermethrin concentration 1433  $\mu\text{g}/\text{cm}^2$ ; alive at deltamethrin concentration 500  $\mu\text{g}/\text{cm}^2$  or higher). An additional category, Knockdown-Recovered (flies appearing to be dead or morbid at cypermethrin concentration 1433  $\mu\text{g}/\text{cm}^2$  but recovered) was created following observations of fly behaviour during bioassay testing. The DPI buffalo fly colony was sampled and RNA extracted (RNeasy Mini Kit, Qiagen) to sequence the VGSC gene. DNA was extracted from field collected flies using a DNeasy Blood and Tissue Kit (Qiagen) to screen for resistance-linked mutations using DNA primers developed in this study.

## Results

The complete VGSC gene has been sequenced for buffalo fly and a putative new resistance mutation, *T929I*, was found in Domain II, subunit 5 of field collected resistant flies (Figure 1). A new class of resistance, knockdown recovery, has been observed in buffalo flies for the first time.



**Figure 1. Buffalo fly voltage gated sodium channel gene with stars indicating the relative position of resistance mutations.**

## Discussion and conclusion

Mutations in the VGSC gene were found to explain 82% of cypermethrin and deltamethrin resistant flies. The *T929I* mutation has been shown to provide a synergistic enhancement to mutation *L1014F* in other insects and may be doing the same in buffalo fly. Knockdown-recovery in other insects has been linked to the elevated expression of detoxifying enzymes. This alternative pathway may explain how 18% of flies without VGSC resistance mutations survive high concentrations of insecticide. Developing a better understanding of insecticide resistance in buffalo fly will inform integrated pest management (IPM) strategies to enable the cattle industry to better control this economically significant pest.

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<sup>B</sup> Corresponding Author: Jessica.morgan@dpi.qld.gov.au

# Safeguarding beef production with rapid chemical resistance tests in ticks

Hannah Siddle<sup>A,D</sup>, Mikayla Crouch<sup>A</sup>, Guilherme Marcondes Klafke<sup>B</sup>, Ala Tabor<sup>A, C</sup>

<sup>A</sup> The University of Queensland, Queensland Alliance for Agriculture & Food Innovation, Centre for Animal Science, St Lucia 4072, Queensland, Australia; <sup>B</sup> Desidério Finamor Veterinary Research Institute, The Department of Agricultural Research and Diagnosis of the Secretariat of Agriculture, Livestock, and Irrigation, Brazil; <sup>C</sup> The University of Queensland, School of Chemistry & Molecular Biosciences, St Lucia 4072, Queensland, Australia

## Introduction

Cattle ticks are a significant burden on global agriculture, cattle performance and global food security. Chemical treatments are the only method of control, but ticks are adapting and building resistance to these chemicals. In parts of South America ticks are resistant to most commercial chemicals, leaving cattle vulnerable to ticks and tick-borne disease (Klafke et al., 2024). In Australia, there is reported resistance to 4 of the 7 acaricide classes, with synthetic pyrethroid and organophosphate resistance (Jonsson and Hope, 2007). Current tests for chemical resistance are slow (6 weeks), expensive and require laboratory facilities, inhibiting testing and prevention of resistance. In this Australian Research Council funded project, we aim to; 1) survey cattle producers to gain an in depth understanding of acaricide use, 2) develop rapid and cost-effective tests to identify cattle ticks resistant to chemical control and, 3) use these methods to survey chemical resistance across Northern Australia and build a database of real time monitoring of resistance.

## Methods

A survey has been developed to better understand acaricide use by cattle producers, treatment regimens and the extent of testing for resistance. The survey will allow potential hotspots for acaricide resistance to be identified, and collection of ticks will be undertaken across Northern Australia for 48 months. A novel test for chemical resistance (RaTexT) will be optimised to allow rapid, on-farm testing for chemical resistance that can distinguish adult ticks as susceptible or resistant to specific chemicals in 24 hours. Genetic markers defining acaricide resistance in ticks will be identified to develop rapid, flexible molecular tests.

## Results

While the project is in the preliminary stages, funding has been secured and a collaboration formed with Boehringer Ingelheim and TBD International, the developers of the RaTexT rapid testing kit. The survey of cattle producers has been launched and a draft genome assembly for the Australia cattle tick has been sequenced, to be used for genetic marker discovery.

## Discussion and conclusion

The study will allow rapid tests for chemical resistance to be developed to deliver informed product selection for tick control. Rapid molecular tests will be applicable to multiple life stages of the tick and make possible a single test to detect resistance to multiple chemicals, leading to more efficient product use, slowing down and even preventing further resistance. We are seeking collaboration from producers across Northern Australia to participate in the survey and to collect ticks for analysis.

## References

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This research is supported by Boehringer Ingelheim, TBD International and an ARC Industry Fellowship, IM250100185.

<sup>D</sup> Corresponding author: h.siddle@uq.edu.au

# RaText<sup>®</sup> as a rapid field alternative to laboratory bioassays for detecting acaricide resistance in cattle ticks

Guilherme Klafke <sup>A,B,E</sup>, Priscila T. Ferreira <sup>B</sup>, Barbara Rauta Avelar <sup>C</sup>, Laura Berger <sup>A</sup>, Frans Jongejan <sup>A,D</sup>

<sup>A</sup> TBD International BV, Amsterdam, The Netherlands; <sup>B</sup> Instituto de Pesquisas Veterinárias Desidério Finamor, Eldorado do Sul, Brazil. <sup>C</sup> Universidade Federal Rural do Rio de Janeiro, Brazil. <sup>D</sup> University of Pretoria, Onderstepoort, Republic of South Africa.

## Introduction

Acaricide resistance in *Rhipicephalus microplus* increasingly limits cattle tick control (FAO, 2025). Available bioassays (adult immersion test – AIT and the larval packet test - LPT) require specialised laboratories and long turnaround times (6 weeks), incompatible with rapid decision-making on farms. RaText<sup>®</sup> is an innovative pen-side test based on exposing semi-engorged adult ticks to acaricide-impregnated matrices, producing resistance classification within 24 h (Jongejan et al., 2024). This study compared RaText<sup>®</sup> with AIT and LPT, while assessing its practicality and diagnostic reliability under routine field conditions.

## Methods

Semi-engorged adult *R. microplus* females from a susceptible laboratory strain and two Brazilian field populations were exposed to deltamethrin and to cypermethrin/chlorpyrifos/PBO using RaText<sup>®</sup>. The same populations were evaluated by AIT and LPT. Mortality outcomes across assays were analysed using binomial Generalised Linear Models (GLM). Effects were expressed as odds ratios (OR) with 95% confidence intervals. Field applicability was assessed through internal replicate accuracy, inter-observer agreement and the minimum number of ticks required per test, using data from 63 RaText<sup>®</sup> boxes and two independent observers.

## Results

RaText<sup>®</sup> showed strong agreement with laboratory assays for deltamethrin. Mortality measured by RaText<sup>®</sup> did not differ from AIT (OR = 1.42;  $p = 0.23$ ), and both assays identified high resistance in both field isolates, corroborated by LPT (resistance ratio - RR = 33.8–39.5). For the cypermethrin/chlorpyrifos/PBO, RaText<sup>®</sup> produced lower mortality than AIT (OR = 0.17;  $p < 0.001$ ). LPT identified low resistance levels (RR = 5.2–7.2). Operationally, RaText<sup>®</sup> required only one replicate with 32 ticks to achieve 91.3% accuracy. Agreement between independent observers was substantial ( $\kappa = 0.664$ ; AC1 = 0.707).

## Discussion and conclusion

RaText<sup>®</sup> showed strong agreement with AIT and LPT for deltamethrin, reliably identifying high resistance in field populations. For the cypermethrin–chlorpyrifos mixture, it produced lower mortality than AIT but still mirrored the resistance pattern confirmed by LPT. Requiring only one replicate with 32 ticks and showing substantial observer agreement, RaText<sup>®</sup> offers rapid, practical, and field-ready resistance diagnosis that complements laboratory assays and supports timely, evidence-based acaricide selection.

## References

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<sup>E</sup> Corresponding author: guilherme-klafke@agricultura.rs.gov.br

# Assessing the effectiveness of a new type of insecticidal cattle ear tag

T Schatz<sup>A,D</sup>, P Jones<sup>B</sup>, J Palmer<sup>C</sup>, M Hearnden<sup>A</sup>

<sup>A</sup> NT DAF, Berrimah Farm, Darwin NT 0801; <sup>B</sup> Y-TEX Corporation, Cody, Wyoming USA 82414; <sup>C</sup> NT DAF, Beatrice Hill Farm, NT 0822.

## Introduction

With the recent ban of Diazinon for use on cattle in Australia there is a need to develop new insecticidal cattle ear tags with different active ingredients that can effectively repel buffalo flies and replace Diazinon based tags in rotation programs. Tag rotation is a critical management tool in preventing the development of resistance to fly tags in buffalo fly populations. This trial was conducted to test a new tag developed by Y-TEX<sup>®</sup> Corporation that contained a new combination of active ingredients, one of which represents a new class of active for the buffalo fly tag market in Australia.

## Methods

Brahman heifers were randomly allocated to either a CONTROL (n = 26) or TAGGED (n = 26) treatment group on 12 December 2024 (Day 0). TAGGED animals were fitted with a sustained-release plastic tag in each ear while the CONTROL group did not receive any treatment for fly control. The heifers had been grazing as one mob until day 0, but from then the treatment groups grazed in separate but similar neighbouring paddocks with ad libitum access to mineral lick blocks and were managed in the same way throughout the study. Fly counts were conducted seven days prior to the start of the trial, on day 0, and then weekly for 24 weeks. The number of flies on the offside of each animal was estimated visually in the paddock from a vehicle that was driven alongside each animal. This number was doubled to estimate the total number of flies on the animal.

## Results

The mean number of flies on animals in each group was not different prior to day 0 and generally remained at or above pre-trial counts in the Control group for the entire trial period. Counts after week 10 were consistently around 500–700 with a peak burden of 800 per animal in week 22.

Mean fly counts in the TAGGED group remained significantly lower than the Control throughout the 24 weeks of the study. They were less than 10–15 per animal until week 21 and remained below 25 until the trial finished after 24 weeks (Figure 1).

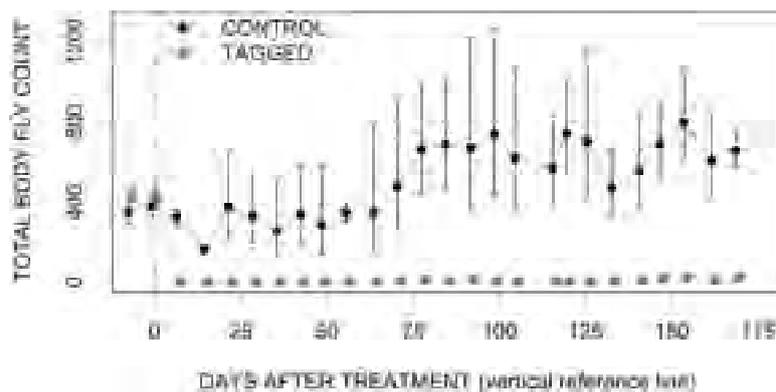


Fig. 1. The mean total count of buffalo flies per animal (with 95% confidence limits).

## Discussion and conclusion

The new buffalo fly tags were effective at repelling flies for the full 24-week study. By comparison, the control group recorded 200–800 flies per animal over the same period. This suggests that the tags will be effective and will be a valuable additional option to use in fly tag rotation programmes to help decrease the development of resistance.

<sup>D</sup> Corresponding author: tim.schatz@nt.gov.au

# Pilot trial of a whole-cell killed Bovine Genital Campylobacteriosis vaccine

Zhetao Zhang<sup>A</sup>, Chian Teng Ong<sup>A</sup>, Hannah V. Siddle<sup>A</sup>, Mst Sogra Banu Juli<sup>A</sup>, Ala E. Tabor<sup>A, D</sup>, Gry B. Boehansen<sup>A, B, D</sup>

<sup>A</sup> The University of Queensland, Queensland Alliance for Agriculture & Food Innovation, Centre for Animal Science, St Lucia 4072, Queensland, Australia; <sup>B</sup> The University of Queensland, School of Veterinary Science, Gatton 4343, Queensland, Australia

## Introduction

Bovine Genital Campylobacteriosis (BGC) is a venereal disease (VD) that causes infertility in cows, transmitted by asymptomatic bull carriers. In Northern Australia, herd prevalence has been reported at 4–14%, with associated annual economic losses of \$43.7 million AUD (McGowan et al., 2014; Shephard et al., 2022). BGC is caused by two biovars of *Campylobacter fetus* subspecies *venerealis* bacteria. The current VibroVax® (Zoetis Aust.) vaccine is prepared from whole-cell killed isolates of both biovars originating from Victoria. The objective of the study was to prepare and test a whole-cell killed BGC vaccine using biovars collected from northern Australia in mature bulls.

## Methods

Twelve *C. fetus venerealis*-naïve bulls (1.5–2 years old) were randomly allocated into two groups with similar weight distributions and mean values. The vaccinated group (n = 6) received the whole-cell killed vaccine (20 mg dry mass of each biovar: strains 957 and 537) with adjuvant, while the control group (n = 6) received a mock PBS solution with adjuvant. Bulls were vaccinated twice, with a four-week interval. Two weeks after the second vaccination, bulls were challenged with two biovar isolates (strains 76223 and 924) on two separate occasions, two weeks apart. Weights and body condition scores were recorded throughout the trial to assess vaccine safety. Blood samples were collected to evaluate the antibody (IgG) response using ELISA and to compare with the responses of the commercial vaccine. Preputial samples were collected to assess infection status and bacterial load via quantitative Polymerase Chain Reaction (qPCR) assays.

## Results

No adverse effects were observed following vaccination or challenge. None (0/6) of the vaccinated bulls became infected after either challenge, whereas two (2/6) control bulls became infected following the first challenge and remained positive until the end of the study (42 days after the first challenge). qPCR analysis showed lower bacterial loads in the vaccinated group 2 days after challenge, suggesting more rapid clearance. ELISA confirmed that the experimental vaccine induced a systemic immune response against *C. fetus venerealis* biovars, with antibody levels comparable to responses to the commercially available vaccine.

## Discussion and conclusion

Our trial demonstrates that a whole-cell killed vaccine effectively induced antibody responses and conferred protection against *C. fetus venerealis* infection in bulls. Although only two control bulls were infected, which may be due to the difficulty of experimental challenge and the use of young bulls, the results provide strong preliminary evidence of vaccine efficacy. This work represents an important step towards developing a combination VD vaccine to safeguard the Northern Australian beef industry.

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<sup>D</sup> Corresponding authors: a.tabor@uq.edu.au; g.boehansen@uq.edu.au

# The occurrence of vaccine injection site reactions in a northern beef herd

Caity Kelly<sup>A,B</sup>

<sup>A</sup> NT Department of Agriculture and Fisheries, Katherine 0850

## Introduction

Vaccination lumps are often attributed to dirty or blunt needles and needle orientation (McIntosh, 2024) and can be associated with adjuvants (Heegaard et al., 2011). Thus, best practice cattle vaccination information provides guidelines on the optimal placing, needle type and angle, sterilisation, needle maintenance and environmental conditions (McIntosh, 2024). However, producers who follow these instructions still report a high prevalence of injection site reactions, causing both rejection for live export and abattoir penalties. Chirase et al., (2001), reported carcass audits showing that 93.2 to 99.9% of lesions were chronologically aged, suggesting these occurred from injections early in the animal's life (e.g. at weaning).

## Methods

Young Brahman and Brahman cross weaners (n=411, mean liveweight 164 kg) were given their weaning vaccinations at the Douglas Daly Research Farm, NT. They were given an aluminium adjuvanted 7-in-1 vaccine (Websters<sup>®</sup> 7-in-1, Virbac Australia) and a Botulism vaccine (SingVac<sup>®</sup>, Virbac Australia) with an oil-based double emulsion adjuvant on 12 June 2025, and a second 7-in-1 vaccination on 29 July 2025. These vaccines were given subcutaneously, using best practice and vaccine instructions. Vaccines were kept cool, vaccine guns were cleaned and dried prior to use, needles were replaced every 50 animals, animals were squeezed in a hydraulic crush to prevent movement, the animal's skin was "tented" to ensure the vaccine was administered subcutaneously and the needle was angled so the bevel was parallel to the skin while injecting. Injections were given at least 10cm apart and were administered in pre-determined locations. Observations were undertaken seven and 14 weeks after the first injection date. The injection reactions were scored using a scale from 1 to 5, where 1 related to a lump of 1 cm in diameter and 5 related to a lump of 5 cm or larger in diameter.

## Results

85% of animals presented a vaccine lump reaction from at least one of the vaccines, with 47% exhibiting two or more reactions. Most lumps were <3cm, with no animals having lumps bigger than 3cm from the first 7-in-1 vaccination and only 6% of the botulism reactions were ≥3 cm after 14 weeks.

**Table 1. Percentages of animals that displayed an injection reaction for each vaccine.**

Time after injection	7-in-1 1 <sup>st</sup> dose (%)	7-in-1 2 <sup>nd</sup> dose (%)	Botulism (%)
7 weeks	29	51	65
14 weeks	29	<i>Measurements still to be taken</i>	68

## Discussion and conclusion

Industry advice suggests that there should be minimal vaccine lump occurrence when best practice methods are adhered to, and lumps should not persist past four weeks after injection. These results demonstrate that vaccine lumps persist longer than 14 weeks and suggests that further research is required to determine reasons for high vaccine lump prevalence in northern herds and if different practices can be implemented to reduce the incidence of vaccination lumps.

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<sup>B</sup> Corresponding author: caity.kelly@nt.gov.au

# Efficacy and safety of an Australian whole-cell killed *Tritrichomonas foetus* vaccine in *T. foetus* naïve young bulls

Harvey Santos<sup>A</sup>, Kieren McCosker<sup>A</sup>, Michael McGowan<sup>B</sup>, Hannah Siddle<sup>A</sup>, Loan Nguyen<sup>A</sup>, Ali Raza<sup>A,C</sup>, Gry Boe-Hansen<sup>A,B,E</sup>, Ala Tabor<sup>A,D,E</sup>

<sup>A</sup> The University of Queensland, Queensland Alliance for Agriculture & Food Innovation, Centre for Animal Science, St Lucia 4072, Queensland, Australia; <sup>B</sup> The University of Queensland, School of Veterinary Science, Gatton 4343, Queensland, Australia; <sup>C</sup> University of New England, School of Environmental and Rural Science, Armidale 2351, New South Wales, Australia; <sup>D</sup> The University of Queensland, School of Chemistry & Molecular Biosciences, St Lucia 4072, Queensland, Australia

## Introduction

Bovine trichomonosis is caused by the protozoan parasite *Tritrichomonas foetus*, which reduces cattle reproductive efficiency. Bulls are asymptomatic carriers, transmitting the parasite to cows. In Northern Australia, approximately one in ten bulls is positive; however, a vaccine is not available due to import restrictions (Irons *et al.*, 2022). Most studies demonstrate vaccine efficacy in cows, but fewer vaccine trials have been undertaken in bulls (Clark *et al.*, 1983; Ortega-Mora *et al.*, 2022). A previous study in older mature bulls confirmed safety with little effect on infection clearance, highlighting the need to assess prophylactic vaccination in younger bulls (Santos *et al.*, 2025). This study evaluated the safety, immunogenicity, and efficacy of an Australian whole-cell killed *T. foetus* vaccine (TfOz5) in naïve young bulls followed by experimental challenge.

## Methods

Sixty *T. foetus*-negative tropical composite bulls (~18 months old) were stratified by weight and randomly assigned to vaccine (n = 30) or control (n = 30) groups. Vaccinated bulls received two subcutaneous doses of TfOz5 ( $5 \times 10^7$  inactivated cells) on Days 0 and 27; controls received adjuvant plus PBS. Bulls were challenged artificially directly into the preputial cavity with a heterologous *T. foetus* isolate (TfOz-N36) on Days 41 and 69. Preputial samples were collected fortnightly for culture and qPCR. Serum IgG antibodies were measured by ELISA. Safety was assessed by observing body weight, and local reactions.

## Results

The vaccine was well tolerated, with no systemic adverse effects and no significant weight or average daily gain differences ( $p = 0.26$ ). Mild local reactions occurred in both groups. Vaccination significantly reduced infection duration (14 vs 40 days;  $p = 0.0044$ ), with 70% of vaccinated bulls remaining negative versus 32% of controls. Parasite load was consistently lower in vaccinated bulls ( $p=0.0002$ ). Vaccination elicited strong systemic antibody response to *T. foetus*.

## Discussion and conclusion

Prophylactic vaccination of *T. foetus* naïve young bulls with TfOz5 reduced infection duration and parasite load, supporting its potential role in bovine trichomonosis control. Future field studies should assess reproductive outcomes in vaccinated heifers and the feasibility of annual vaccination boosting. Overall, the TfOz5 vaccine was safe, immunogenic, and effective in reducing parasite load and clearing time.

## References

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Ortega-Mora *et al.*, (2022) Frontiers in Veterinary Science 9 1005556  
Santos *et al.*, (2025) Parasitology 1-33

<sup>E</sup> Corresponding authors: a.tabor@uq.edu.au; g.boehansen@uq.edu.au

This research was supported by MLA Donor Company grant P.PSH.1369 with HancockAg and AEA Seed AE230200056 with AACO.

# Using a test and cull strategy reduces Trichomonosis prevalence in Northern Australia beef bulls

Matthew Kelly<sup>A,C</sup>, James Copley<sup>A</sup>, Caiti Rosengren<sup>A</sup>, Eliza Gray<sup>A</sup>, Michael McGowan<sup>B</sup>, Benjamin J Wood<sup>B</sup>

<sup>A</sup> Australian Agricultural Company, Newstead 4006; <sup>B</sup> School of Veterinary Science, University of Queensland, Gatton 4343

## Introduction

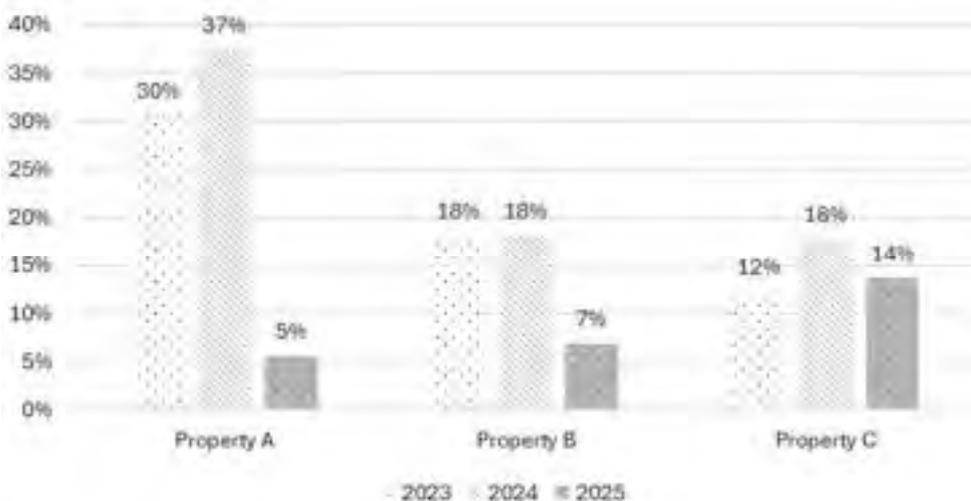
Bovine trichomonosis (*Tritrichomonas foetus*) is a venereal disease prevalent in Northern Australia beef herds. The pathogen is associated with early abortions and delayed pregnancy in both heifer and cow herds. Bulls that harbour the disease are asymptomatic with diagnosis possible by preputial scrape and PCR identification. As no vaccine is commercially available in Australia to protect against trichomonosis, the only viable option to reduce prevalence is testing and culling of infected animals.

## Methods

Trichomonosis sampling was completed on preputial scrapings using a tricamper device. All bulls that were mustered were sampled across three properties in 2023 (n = 1370), 2024 (n = 3237), and 2025 (n = 1527). These samples were submitted for PCR testing to detect the presence of the organism. The intent was that bulls that returned positive results were identified and culled from the herd to prevent further transmission of the parasite.

## Results and discussion

Substantial reductions in prevalence were observed at property A and property B, particularly in the third year of sampling, as shown in Fig. 1. Property C observed a smaller decrease, and this reflected less stringent culling of bulls, less control of neighbour bulls and an older, aging bull population. Results from the three properties show that reducing the prevalence of *T. foetus* in northern herds is possible by using a test and cull strategy. However, these results require a long-term commitment as significant reductions were not observed until the third year of the program.



**Fig 1. *Tritrichomoniasis foetus* prevalence from three properties from 2023 to 2025 after the implementation of a test and cull strategy.**

Eradication remains a significant challenge because of poor bull control and turnaround times from sampling to time of cull. The logistical challenge of transporting samples to a central laboratory for analysis is problematic and the use of on farm or different detection procedures may be warranted.

<sup>C</sup>Corresponding author: mkelly1@aaco.com.au

# The case for on-animal sensors as a tool for endemic and exotic disease surveillance

Mark Trotter<sup>A,B</sup>, Thomas Williams<sup>A</sup>, Ryan Reuter<sup>C</sup>, Derek Bailey<sup>D</sup>, Frank Garry<sup>E</sup>

<sup>A</sup> Institute for Future Farming Systems, CQUniversity, Rockhampton; <sup>C</sup> Oklahoma State University USA, <sup>D</sup> Deepwell Ranch Arizona USA, <sup>E</sup> Colorado State University USA

## Introduction

Northern Australia supports over half of the national beef herd across vast, extensive rangelands. Properties often exceed hundreds of thousands of hectares and stock are mustered only a few times each year. This scale, combined with distance to diagnostic laboratories and veterinary services, creates major challenges for disease surveillance. Endemic conditions such as bovine ephemeral fever and pestivirus already impose productivity and welfare costs, while exotic threats including foot-and-mouth disease (FMD), and lumpy skin disease pose significant biosecurity risks.

Despite increased deployment of biosecurity officers and surveillance initiatives, the remoteness of northern regions means incursions could spread widely before detection. Current systems rely heavily on visual inspection at muster or on passive reporting, both of which are constrained by infrequency and subjectivity. Traditional approaches have included sentinel herds strategically positioned for disease monitoring, yet these remain limited by geographic coverage and the need for regular sample collection. In this context, on-animal sensors represent a critical opportunity. By enabling sentinel animals within commercial herds to provide continuous data on movement, behaviour and physiology, sensors can extend surveillance reach and offer earlier signals of incursion, aligning with the goals of the Northern Australia Biosecurity Strategy 2030 (DAFF 2024). This paper proposes a model that could be adopted to improve disease surveillance in Northern Australia.

## Discussion and conclusion

Sensor-based detection involves the continuous monitoring of cattle through devices such as GPS collars, accelerometers and ear-tag sensors, which capture changes in rumination, activity, movement and social interactions. Positioning a subset of “smart” cattle as sentinel animals could create a distributed surveillance network across northern herds. This would provide near-real-time insights from remote locations, complementing the work of biosecurity officers and strengthening the national system of early detection.

Research in Northern Australia has shown that accelerometers can identify behavioural deviations associated with bovine ephemeral fever earlier than visual inspection (Trieu Ly Ly et al., 2025). At the herd scale, sensor data could also support detection of broader reproductive events. For example, mass abortion outbreaks linked to bovine viral diarrhoea virus (BVDV) may be reflected in unexpected changes to activity, return to oestrus or calving patterns, providing another layer of surveillance for endemic disease impacts. The acute clinical signs and behavioural changes associated with exotic diseases such as foot-and-mouth disease and lumpy skin disease may lend themselves to being identified using on-animal sensors, providing the potential for earlier detection and more rapid response.

For Northern Australia, where surveillance coverage is stretched by distance and scale, sentinel animals with on-animal sensors provide a pathway to proactive, continuous monitoring. Adoption at scale would help shift surveillance from reactive to predictive, enhancing resilience against both endemic disease burdens and the threat of exotic incursions. Although not without its challenges, we propose that sensor-enabled sentinel animals be formally integrated into northern surveillance systems to provide a practical, scalable and proactive approach to biosecurity preparedness.

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<sup>B</sup> Corresponding author: m.trotter@cqu.edu.au

# Validation genomic breeding values for beef female fertility

Elsie Vincent <sup>A,C</sup>, Geoffry Fordyce <sup>B</sup>, Shannon Speight <sup>A</sup>, Ben Hayes <sup>B</sup>

<sup>A</sup> Base Pair Genomics Mareeba, Qld 4880; <sup>B</sup> QAAFI, UQ, St Lucia 4072

## Introduction

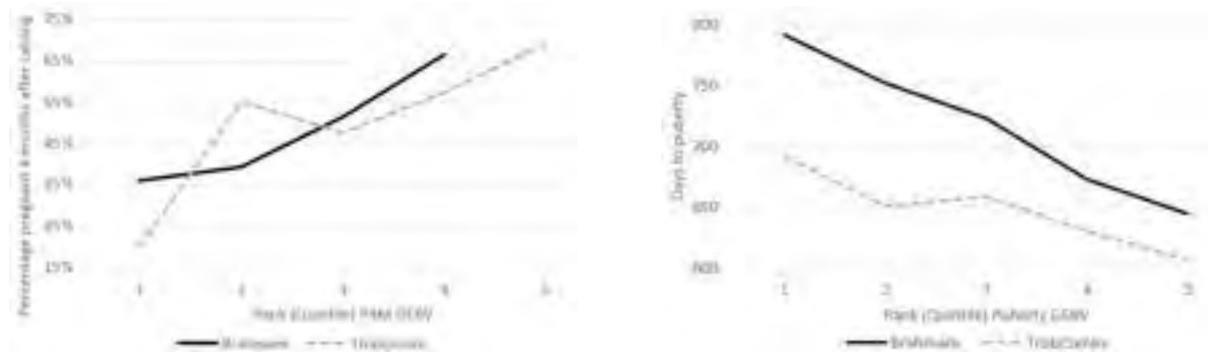
Genomic estimated breeding values (GEBV) that predict liveweight production were developed in tropically adapted purebred and crossbred beef cattle (Hayes *et al.*, 2025). Fertility traits (puberty and pregnant within 4 months of calving - P4M) were identified as significant predictors of liveweight production. In this study, a GEBV validation was conducted using an independent Beef CRC data set in which fertility traits were measured and genotypes available (Johnston *et al.*, 2013).

## Methods

Beef CRC phenotypes for age at puberty and P4M were plotted against GEBV quintile groups. Age at puberty phenotypes were assessed by presence, or not, of a corpus luteum, and P4M is calculated from the heifer pregnancy and second-pregnancy foetal ages. The Beef CRC population of 536 Brahman and 841 Tropical composite females were distinguished by quintiles where quintile group 1 consists of the bottom 20% of GEBVs, quintile group 3 is the average, and quintile group 5 consists of the highest 20%.

## Results

Increasing GEBV was directly related to better phenotype averages for both puberty and P4M in both Brahmans and Tropical composites. The exception is Tropical composite GEBV quintile group 2 in which the phenotypes were higher than expected for P4M, and puberty quintile group 2 and 3 where it was expected that group 2 would have later days to puberty than group 3. Both deviations are reflections of variations in real phenotypic data.



Figures 1a and b. Relationship between GEBV quintile group (for a) P4M and b) Puberty) and fertility phenotypes for both Brahmans and Tropical composites

## Discussion and conclusion

This validation study found that GEBVs for puberty and P4M were good predictors of phenotype in an independent dataset, supporting their use for selection. Even with moderate accuracy, using GEBV in selection of bulls for heifer puberty and P4M will clearly be efficacious in achieving improved female fertility in offspring. This will directly improve liveweight production of north Australian beef businesses (Hayes *et al.*, 2025).

## References

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<sup>C</sup> Corresponding author: [elsie@blackboxco.com.au](mailto:elsie@blackboxco.com.au)

# Incidence of *Tritrichomonas foetus* increases with bull age indicating culling for age may be a suitable control option

Benjamin J Wood<sup>A,C</sup>, James Copley<sup>B</sup>, Caiti Rosengren<sup>B</sup>, Eliza Gray<sup>B</sup>, Michael McGowan<sup>A</sup>, Matthew Kelly<sup>B</sup>

<sup>A</sup> School of Veterinary Science, University of Queensland, Gatton 4343; <sup>B</sup> Australian Agricultural Company, Newstead 4006

## Introduction

Trichomonosis (*Tritrichomonas foetus*) is a venereal disease of cattle characterised by early foetal mortality and infertility. Early foetal loss will present as prolonged calving intervals and lower than expected pregnancy rates. Literature describing the presentation of the disease in Northern Australia is limited, with its impact considered minimal despite the pathogen being endemic with reported infection rates of up to 15.4% (Irons et al., 2022). The true effect of the disease may be masked with concurrent losses in both pregnancies and calves to other endemic diseases such as vibriosis and nutritional and environmental challenges. Two key issues exist in the management of the pathogen. Firstly, it is spread to females by bulls that are typically asymptomatic and secondly, treatment or control method such as a vaccine is not commercially available in Australia. A possible control strategy was conceived to lower the endemic incidence by conducting a “test and cull” program from 2023–2025. By conducting a widespread testing program on all available bulls within a station a consequence of the program was to obtain accurate estimates of prevalence within farm, within paddock and within age cohorts. It had been shown previously that age of bull influenced prevalence, and the aim was to identify if this was true within bulls across a number of AACo properties.

## Methods

All herd bulls mustered on three AACo properties were preputial sampled using the recommended tricamper device, scrapings were transferred to phosphate buffered saline (PBS), chilled and transported to the laboratory. Samples were quantified as positive, negative or inconclusive using a validated qPCR. Bulls were held within holding paddocks after sampling and either culled or returned to the herd based on the result. The period between sampling and laboratory results returned and actioned was typically between 2 and 4 weeks.

## Results

**Table 1. *Tritrichomonas foetus* positive rate by bull age within testing years 2023 to 2025.**

Age (y)	2023	2024	2025	Overall
3	0.0%	16.6%	0.0%	9.4%
4	20.4%	23.3%	7.5%	15.9%
5	34.1%	44.9%	5.3%	39.3%
6	37.9%	41.8%	9.8%	32.1%
7	40.0%	49.5%	15.0%	43.7%

A total of 6033 bulls were sampled, of which 948 returning a positive Trichomonosis result. Overall infection rates have noticeably declined between years 2024 and 2025. Of interest was the distribution across age classes and it was shown that Infection rate increased with age from 15.9% for 4YO bulls to 43.7% for 7YO's (Table 1).

## Discussion and conclusion

The results indicate that infection risk for bulls increases with age although this risk was observed to plateau after 6 years-of-age. Prevalence has declined suggesting that the test and cull strategy is decreasing the pathogen load. The results also suggest that keeping the median age of bulls low (<6) will assist with reducing the overall infection rate.

## References

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<sup>C</sup> Corresponding author: b.j.wood@uq.edu.au

# Pawitive pregnancy: investigating detection dogs for cattle pregnancy diagnosis

Ella Watkins<sup>A,D</sup>, Kieren McCosker<sup>A,B</sup>, Andres Gambini<sup>A,C</sup>, Gry Boe-Hansen<sup>A,B</sup>

<sup>A</sup> School of Veterinary Science, The University of Queensland, Gatton, Queensland 4343, Australia; <sup>B</sup> Queensland Alliance for Agriculture and Food Innovation, The University of Queensland, Gatton, 4343, Australia; <sup>C</sup> School of Agriculture and Food Sustainability, The University of Queensland, Gatton, Queensland 4343, Australia

## Introduction

Whole-herd pregnancy testing is still not routinely practiced by many northern beef operations. Current methods are perceived to require additional staff, reduce cattle processing speed, and require skilled personnel who are not always available. Clean musters can be difficult in extensive systems. Therefore, a proportion of cows present at the yards when technicians are not available, undermining effective management. Developing a simple, non-invasive pregnancy detection tool would increase management flexibility and improve herd productivity through more timely and informed decisions.

Dogs possess an exceptional sense of smell and have been successfully trained to detect a wide range of biological conditions and diseases in humans and animals. Building on this capability, this study evaluated the feasibility of using trained detection dogs (*Canis lupus familiaris*) to distinguish between pregnant and non-pregnant cattle based on the smell of biological samples, with the goal of developing a practical, low-stress field diagnostic tool for cattle production systems.

## Methods

Three dogs underwent 10 weeks of training using clicker-based positive reinforcement protocols. Two dogs were imprinted on samples from pregnant cattle (positive discrimination), while one dog was imprinted on samples from non-pregnant cattle (negative discrimination). Training included 51 sessions, of which 71% were completed in less than 5 minutes, and 53% included 5–10 repetitions. Vaginal swabs were collected from cattle (n=68; 37 pregnant, 31 non-pregnant) during routine veterinary examinations, with pregnancy status confirmed via rectal palpation at  $\geq 42$  days gestation. Samples were stored under conditions designed to preserve volatile organic compounds associated with reproductive status.

## Results

Training protocols successfully established discrimination behaviour in 2 of the 3 dogs, confirming their ability to detect pregnancy-associated olfactory cues in cattle. Both dogs that successfully conditioned to the training demonstrated consistent discrimination behaviour within a five-arm scent wheel setup, each assigned to either a positive or negative target odour among distractor samples.

## Discussion and conclusion

These preliminary findings support the concept of canine olfactory detection as a novel, non-invasive approach to pregnancy diagnosis in cattle. Ongoing training aims to refine indication responses to achieve clear and reliable discrimination under controlled conditions. These findings demonstrate strong potential for developing canine-assisted pregnancy detection as a practical, non-invasive tool suitable for application in some beef production systems. Current pregnancy testing methods remain highly effective and provide valuable additional information, such as fetal aging, which enables producers to allocate and manage cows as defined calving groups and optimise herd management decisions. The approach investigated is not intended to replace existing techniques but to expand the range of tools available to producers, which will support increased adoption of whole-herd pregnancy testing and evidence based culling decisions to improve production.

This proof-of-concept study establishes a foundation for future research to evaluate the performance of detection dogs under field conditions, identify the specific biological cues detected, and explore potential applications for the development of new diagnostic technologies.

<sup>D</sup> Corresponding author: e.watkins@student.uq.edu.au

# Enhanced multi-breed genomic prediction for bull fertility using breed-adjusted genomic relationship matrices

Antonio Reverter<sup>A,C</sup>, Pâmela A. Alexandre<sup>A</sup>, Marina R.S. Fortes<sup>B</sup>, Laercio R. Porto-Neto<sup>A</sup>

<sup>A</sup> CSIRO Agriculture & Food, 306 Carmody Rd., St. Lucia, QLD, Australia; <sup>B</sup> School of Chemistry and Molecular Bioscience, The University of Queensland, St Lucia, QLD, Australia

## Introduction

Climate change adaptation in tropical beef systems requires genetic selection tools that enhance reproductive efficiency across diverse breeding environments. Many Australian tropical bull producers operate without formal genetic improvement programs, creating opportunities for multi-breed genomic prediction to open access to genetic technologies (Porto-Neto et al., 2023). We compared genomic predictions using breed-specific allele frequency adjustments in genomic relationship matrices (GRM) with traditional GRM to establish a methodological foundation for the development of multi-breed genomic predictions, using tropical bull fertility as an example.

## Methods

A multi-breed dataset comprising 2,824 bulls from Brahman (n=1,051), Santa Gertrudis (n=929), and UltraBlack (n=844) populations were analysed using high-density genotype data and phenotypic records for scrotal circumference (SCC), sheath score (SHE), and percentage of normal sperm (PNS). Genomic estimated breeding values (GEBVs) were computed using a standard GRM (GRM\_u) and a breed-adjusted GRM (GRM\_a) that accounts for breed-specific SNP allele frequencies. Heritability estimates and prediction accuracies were evaluated through variance component analysis and random cross-validation schemes.

## Results

The GRM\_a demonstrated superior performance, with diagonal elements conforming to expected distributions around one (range: 0.844-1.391) versus the problematic multi-modal distribution observed in GRM\_u (range: 1.022-1.524, mean: 1.163). While heritability estimates ( $h^2$ ) were comparable for SCC and SHE, they were higher for PNS using GRM\_a (Table 1). Importantly, prediction accuracies for all three fertility traits showed improvements under GRM\_a. Strong correlations (>0.90) between GEBVs from both approaches indicated consistent animal rankings despite methodological differences.

**Table 1. Analysis summary for scrotal circumference (SCC), sheath score (SHE), and percentage of normal sperm (PNS).**

Trait	Mean±SD	GRM_u $h^2$	GRM_a $h^2$	GRM_u Accuracy	GRM_a Accuracy
SCC	31.82 ± 4.32 (cm)	0.501±0.037	0.434±0.037	0.550	0.571
SHE	3.70 ± 1.98 (score)	0.458±0.037	0.439±0.038	0.496	0.509
PNS	63.34 ± 28.22 (%)	0.362±0.030	0.226±0.032	0.335	0.423

## Discussion and conclusion

Breed-adjusted genomic relationship matrices enhanced prediction accuracy for tropical bull fertility traits. These enhancements are particularly valuable for bull fertility traits where accurate genetic evaluation also impacts genetically correlated female fertility outcomes. The consistent improvement across traits lays a strong methodological foundation for the development of a tropical bull fertility index that will integrate these traits into a single selection tool. Future work will focus on incorporating additional fertility measurements and populations, establishing economic weightings for component traits, and validating the index against existing fertility evaluations.

## References

Porto-Neto et al., (2023) PLoS One 26;18(1):e0279398

<sup>C</sup> Corresponding author: toni.reverter-gomez@csiro.au

# Genomic benchmarking in commercial beef herds to inform bull selection decisions in extensive, northern production systems

*Matt Wolcott<sup>AB</sup>, David Johnston<sup>A</sup>, Trevor Price<sup>C</sup>*

<sup>A</sup> Animal Genetics and Breeding Unit\*, University of New England, Armidale, NSW 2350. <sup>C</sup> Department of Primary Industries and Regional Development, Broome, WA 6725.

## Introduction

The most impactful way to improve genetic profitability in a commercial beef breeding enterprise is to bring bulls into the breeding program which are genetically superior to the current breeding herd, for traits of economic importance. Key information which has been lacking to date is where the commercial breeding herd sits on the spectrum of genetic profitability. BREEDPLAN are developing new genomic tools for commercial breeders which can economically provide this information. The WA state government funded 'Northern Beef Breeding Project' is examining the efficacy of genomic benchmarking in some of the most extensive commercial beef production systems in Australia.

## Exploiting genomic information in extensive, northern commercial beef breeding systems

Genomic benchmarking in commercial beef herds will rely on the recording undertaken in the seedstock sector and in reference populations like the Repronomics™ project which aim to maximise BREEDPLAN EBV accuracy across the range of genetics present in the Australia's registered beef population. Products are under development which will allow commercial beef breeders to strategically genotype a small number of breeding females to generate BREEDPLAN EBVs.

The EBV accuracy commercial breeders can expect will be driven by the relatedness of their herd to the phenotyped and genotyped reference, with the best prior indicator being the EBV accuracy of bulls which have come into the breeding program to produce the animals submitted for testing. However, lowly accurate EBVs can provide extremely useful information when averaged to describe the current genetic position of the herd. These herd average EBVs and selection indexes provide a benchmark for bull selection decisions when considered with reference to the breeding objective.

Critically, by exploiting BREEDPLAN data and analytical methods, the resulting EBVs and selection indexes will be directly comparable to those published for registered bulls. This means that the benchmark (i.e. herd average) EBVs provide a means to directly identify bulls which will move the commercial breeding objective forward at the level of individual BREEDPLAN traits and genetic profitability when basing selection decisions on a BREEDPLAN profit based selection index.

It takes a number of generations for the genetic improvement in the seedstock sector to be expressed in the commercial population, and this increases as production systems become more extensive. Bulls which are average (or even below average) when compared to the registered population could, therefore, favourably impact genetic profitability in a commercial population. Knowing the current genetic position of a commercial breeding herd may, therefore, significantly increase the range of bulls which present real opportunity to improve genetics and profitability.

The optimal number and class of animals (i.e. just heifers or the entire cow herd) to sample will be impacted by the objectives of individual breeders. As these new tools become available, keeping initial numbers sampled conservative (20 – 30 animals) would be recommended as the efficacy of genomic benchmarking will need to be established on a herd by herd basis.

## Conclusion

As part of the WA Northern Beef Breeding Project a number of herds have volunteered to genotype a sample of their breeding females. Results were not available at the time of writing this paper, but herd average EBVs, will be available before the end of 2025 and these results, and their application to bull selection decisions, will be presented at the 2026 NBRUC conference.

<sup>B</sup> Corresponding author: [mwolcott@une.edu.au](mailto:mwolcott@une.edu.au).

\* AGBU is a joint venture of NSW Department of Primary Industries and the University of New England.

# Improving the fertility of a Brahman herd through the use of high fertility bulls in the Northern Territory

Melissa Wooderson<sup>A,B</sup>, Gretel Baily-Preston<sup>A</sup>

<sup>A</sup> Department of Agriculture and Fisheries, Katherine Research Station, NT 0850

## Introduction

*Bos indicus* cattle tend to have a longer anoestrus periods and lower fertility than *Bos taurus* cattle (Entwistle 1983). Anoestrus period has moderate to high heritability in *Bos indicus* cattle and so can be improved through selection (Johnston et al., 2013). The Northern Territory Department of Agriculture and Fisheries (NT DAF) has been selecting for fertility in a Brahman herd (Selected Brahmans) since 1994. Females were selected if they successfully weaned a calf after yearling mating, weaned 2 calves from the first 3 mating opportunities, and successfully weaned a calf each year after this. Male offspring were selected at 18 months using 400-day weight, scrotal size, percent normal sperm as well as their dam's performance (favouring younger age at puberty and more consecutive calves) as well as polledness, temperament and structural soundness

## Methods

NT DAF has two Brahman herds at the Victoria River Research Station; the Selected Brahman herd and a Commercial Brahman herd. From 2009 bulls from the Selected Brahman herd were mated with the Commercial Brahman herd and performance data prior to, and after this was used to evaluate the impact on the fertility of the Commercial Brahman herd. Both herds only contained mature breeders (no heifers) and management of the herds was similar. The percentage of breeders that were lactating and pregnant at the May weaning musters was compared. Data was analysed with a general linear model with breeder class (Selected Brahman or Commercial Brahman) and time as factors.

## Results

The Selected Brahmans had a consistently higher lactating and pregnant (wet/preg) rate compared to the Commercial Brahman herd ( $P < 0.05$ ), but this difference decreased over time as the high fertility genetics became more prevalent in the Commercial herd, with the wet/preg rate increasing more in the Commercial herd than the Selected Brahman herd (Figure 1).

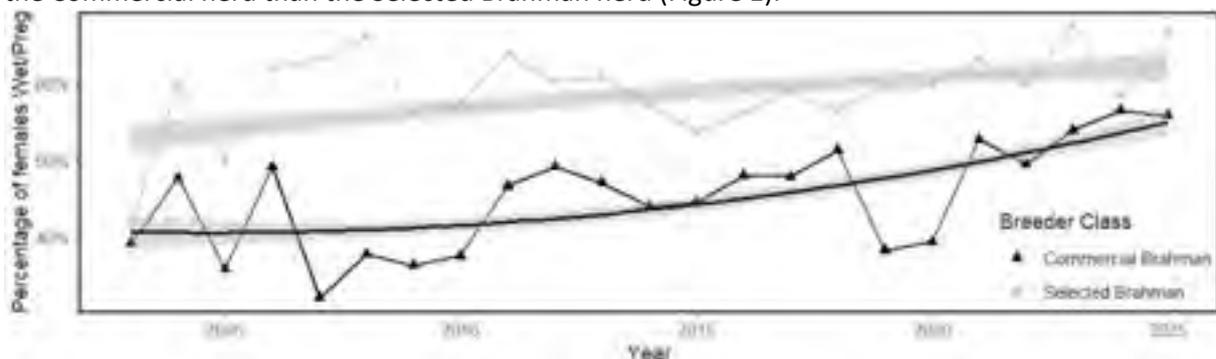


Figure 1. Fitted model of lactating and pregnant (Wet/Preg) rate over time by breeder class.

## Discussion and conclusion

The increase in commercial Brahman herd wet/preg rate demonstrates that the use of high fertility bulls can improve herd reproductive performance. This supports the recommendation to producers of selecting bulls with good fertility trait estimated breeding values (EBVs).

## References

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<sup>B</sup> Corresponding author: melissa.wooderson@nt.gov.au

# Mooternal: Investigating relationships between maternal investment, calf loss and productivity in Northern Australia

Piper Smith<sup>AC</sup>, Christie Pearson<sup>A</sup>, Anita Chang<sup>B</sup>

<sup>A</sup> Northern Territory Department of Agriculture and Fisheries, Katherine 0850; <sup>B</sup> Central Queensland University, Rockhampton 4701

## Introduction

In extensive beef grazing systems of Northern Australia, limitations in animal monitoring and management interventions have led to gaps in understanding the causes of calf loss and what drives calf productivity (Chang *et al.*, 2020). One potential factor that could contribute to calf mortality and poor productivity in these regions is the impact of cow behaviour. The performance, wellbeing, and survival of the calf is heavily reliant upon maternal support for nutrition, protection from predators and coping with environmental challenges (Nevard *et al.*, 2022). It is hypothesised that cows demonstrating behaviours indicating strong maternal investment (willingness to invest time and resources to protect and raise the calf) would have a higher likelihood of raising calves that survive and grow well.

The aim of the Mooternal project is to use sensor systems to explore how maternal care impacts on calf outcomes and how this information can be used to improve calf productivity and survival in Northern Australia. This project will develop a series of tools and algorithms to assist producers in detecting factors contributing to calf loss and low reproductive performance. The insights into maternal investment using precise remote monitoring technology will be crucial for producers to make informed, data-driven management decisions and intervene, when possible, to improve the productivity, sustainability, and profitability of their operation and the northern beef industry.

## Methods

Precision livestock sensors, including accelerometer ear tags and GPS collars, will be used to monitor key movements and activities between parturition and weaning (birth, suckling, oestrous). Commercial and research-grade sensors will be used to collect data and algorithms will be developed for these key activities during the first year. Throughout the second year of the project, the developed algorithms will be validated. The third year of the project will see an expansion of the technology on properties during the calving season to develop a series of case studies describing how the sensors may be applied to detect calf mortality and determine high performing cows.

Accelerometer ear tags and GPS collars were deployed on 100 breeders in a 2215 ha paddock near Katherine, NT in September 2025. During the calving period from October to December, behavioural observations will be recorded on the breeder herd. At the conclusion of the calving period, sensors will be removed, and behavioural data will be analysed to interpret whether certain maternal behaviours impact calf survival and productivity. Algorithms developed from behavioural data may be used to develop commercially available sensors providing an opportunity for producers to closely monitor their animals during calving in extensive environments.

## Results

The project has recently commenced. There are no results at this stage.

## References

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<sup>C</sup> Corresponding author: piper.smith@nt.gov.au

## **‘Beefing Up Genomics’ - A producer driven approach to reference populations**

*Rebecca Burnham<sup>AC</sup>, Michael Lyons<sup>A</sup>, Adam Gunthorpe<sup>A</sup>, Kate Johnson<sup>A</sup>, Rodger Jefferis<sup>A</sup>, Victoria Moffatt<sup>A</sup>, Lance Burnham<sup>A</sup>, Ashley Kirk<sup>A</sup>, Roland Everingham<sup>A</sup>, Jennifer McCamley<sup>A</sup>, Jak Pearson<sup>A</sup>, Matt Wolcott<sup>B</sup>*

<sup>A</sup> Frontier Genetics Inc., ‘Burenda’ Augathella 4477 QLD, Australia.

(<sup>A</sup> See <https://frontiergenetics.com.au/members/> for individual breeder affiliations).

<sup>B</sup> Animal Genetics and Breeding Unit\*, University of New England, Armidale, NSW 2350, Australia.

### **Introduction**

‘Beefing Up Genomics’ project is a Meat & Livestock Australia (MLA) Donor Company (MDC)-funded project led by FRONTIER GENETICS INCORPORATED. It aims to deliver high quality phenotypes and genotypes for economically important traits, complementing the intensive recording undertaken in across-breed reference projects like Repronomics™ and the Northern Beef Information Nucleus (BIN).

### **A co-operative model to drive greater precision for the Brahman BREEDPLAN evaluation**

FRONTIER GENETICS INCORPORATED are a co-operative of 11 Brahman seedstock herds who share a goal to accelerate genetic progress for economically important BREEDPLAN traits within their breeding programs. The group has clearly stated objectives to build on the 5000 recorded breeding female resource under their management to undertake intensive phenotyping and genotyping of hard to measure traits which will drive EBV accuracy across the Brahman breed.

The resulting ‘Beefing Up Genomics’ project has been developed to address recording gaps identified in existing reference populations initiatives, particularly Repronomics™. The project aims to undertake intensive phenotyping and genotyping to maximise the coverage and accuracy of BREEDPLAN EBVs for traits of economic importance to Australia’s northern beef breeders.

While the Repronomics project has been supplemented by MDC collaborations with the Australian Brahman Breeders Association, Droughtmaster Australia and Santa Gertrudis Association to include finishing and slaughter of male progeny for carcass and meat quality data to improve EBV accuracy for these traits, a significant gap in recording traits describing male reproductive performance exists. A critical contribution of the ‘Beefing Up Genomics’ project will be intensive recording of percent normal sperm (PNS) across the co-operator herds. This will represent a significant contribution to the Brahman evaluation as PNS is moderately heritable, provides very useful information about male fertility and female reproduction and has one of the lowest recording levels in the breed’s evaluation.

The project will also supplement the recording of ovarian scanned traits (age at puberty and lactation anoestrous interval) in a subset of its females, which are key drivers of EBV accuracy for female reproduction for the Brahman evaluation.

The project is committed to genotyping all animals and to recording traits that are particularly challenging for northern seedstock breeders, including birth dates & mature cow weights on complete year cohorts of males and females. Importantly, the project will also record the more standard BREEDPLAN traits to ensure that estimates of genetic correlations of hard to measure traits with these can be estimated with the greatest accuracy.

The project has clear objectives around engagement with tropical seedstock and commercial beef breeders, presenting the results of the work at field days and extension and training initiatives which will be developed in co-operation with MLA and other project partners.

### **Conclusions**

The ‘Beefing Up Genomics’ project is committed to delivering real improvements to the quality of the Brahman BREEDPLAN evaluation. It is a testing ground for new and novel ways to economically deliver critical reference data to beef breeders in Northern Australia. We invite interest and collaboration from producers, extension and researchers to ensure the project is a success for industry.

<sup>C</sup> Corresponding author: [info@frontiergenetics.com.au](mailto:info@frontiergenetics.com.au)

\* AGBU is a joint venture of NSW Department of Primary Industries and the University of New England.

# Topical wound treatments targeting haemorrhage and infection in amputation dehorned calves

Samantha Rudd<sup>AC</sup>, Heidi Strong<sup>B</sup>, Sabrina Lomax<sup>B</sup>, Peter White<sup>B</sup>, Dominique Van der Saag<sup>A</sup>

<sup>A</sup>Sydney School of Veterinary Science, The University of Sydney, Camden, NSW; <sup>B</sup>School of Life and Environmental Sciences, The University of Sydney, Camden, NSW

## Introduction

Haemorrhage and infection are thought to be the 2 major causes of mortality and morbidity following amputation dehorning in cattle (Fordyce, et al., 2018). While numerous pain relief products exist, limited products that target these outcomes exist or have been investigated. This project evaluated current commercial products that reduce post-dehorning complications.

## Methods

Forty horned *Bos taurus* calves (200-330kg) were randomly assigned to 1 of 4 treatment groups: untreated negative control (NC), Aluspray<sup>®</sup> (AL), Tri-Solfen<sup>®</sup> (TS), and Tranexamic acid (TXA). Dehorning was performed using scoop or cup dehorning tools, depending on horn size. Wound size, presence of open sinus, and bleeding intensity were recorded immediately following dehorning. Bleeding was then visually assessed at 12 time points over the following 24 hours. Wound healing and infection were visually appraised and scored at 2, 6 and 8 weeks post-dehorning. Wound biopsies were collected at 0, 2 and 6 weeks post-dehorning to analyse wound healing at a cellular level.

## Results

There was no effect of topical treatment on bleeding, infection or visual healing outcomes. Bleeding was most intense at 15 minutes-post-operative and 90% of bleeding had resolved by 6 hours. A positive relationship between open sinus and bleeding score was observed ( $P=0.02$ ).

## Discussion and conclusion

While there was no significant effect of the topical treatments on the desired wound outcomes, this study provided critical information about bleeding, infection and wound healing following amputation dehorning. These results highlight the difficulties of addressing dehorning wounds with excessive haemorrhage and limited tissue for absorption of therapeutics. Analysis of wound biopsy data is currently underway, and results are not yet available. This study was designed to help inform practical wound treatments and measurements in subsequent large scale studies.

## References

Fordyce, (2018). Australian Veterinary Journal, 96(12), pp.508-515.

\*Corresponding author: samantha.rudd@sydney.edu.au

# The effect of lactation anoestrous of first-calf cows on calf weaning weight

K. Hubbard <sup>AC</sup>, T. Grant <sup>A</sup>, D. Johnston <sup>B</sup>, K. Moore <sup>B</sup>

<sup>A</sup> Spyglass Research Facility, DPI, Charters Towers; <sup>B</sup>AGBU, a joint venture of NSW Department of Primary Industries and University of New England, Armidale, 2351

## Introduction

In Australian beef production, lactation anoestrous, the period after calving when a cow is lactating and doesn't experience an oestrous cycle, is a critical factor influencing profitability, particularly in first-calf cows. This paper aimed to determine whether first-calf cows that returned to oestrus by weaning had lighter calves.

## Methods

Data from a subset of Repronomics™ females was analysed and included 371 Brahman and Droughtmaster first-calf cows which were branded in 2021 and 2022 and first calved as 3-year-olds at Brian Pastures (BP) and Spyglass (SG) research stations. At weaning, ovarian ultrasound scanning identified whether females had resumed oestrous, identified by the presence of a corpus luteum (CL). Her calf's liveweight at weaning (WW) in kilograms was recorded at this time. WW was modelled, initially testing fitting fixed effects which described whether a CL was present or not, breed, location (LOC), year (YR), calf sex (CS) (as class terms) and calf age in days (CA) (as a covariate), with the calf's sire fitted as a random effect. Linear mixed models were stepped down, removing terms in order of non-significance to produce the final model of WW ( $P < 0.05$ ).  $R^2$  was estimated for this model, and again after removing the CL terms to determine the variation in WW explained by the CL term.

## Results

The final model included CL, CS, CA (linear and quadratic), LOC, and YR, as well as first-order interactions CL\*LOC and LOC\*YR. The final model  $R^2$  was 0.54, and the  $R^2$  of the final model with CL terms removed was 0.53. The difference indicated that a cow's CL status explained approximately 1% of WW. Table 1 shows the number of records of first-calf cows scanned and least squares means (LSM) for the significant interaction between location and CL status. Although there was no difference in WW within locations, the results showed BP cows with a CL observed weaned heavier calves than Spyglass without a CL observed.

**Table 1. LSM weaner weights for Brian Pastures and Spyglass with and without CL observation**

Location	Trait	Number of first-calf cows	Weaner Weight LSM (Kg)	Standard Error
Spyglass	CL not observed	153	187	1.78
	CL observed	91	180	2.15
Brian Pastures	CL not observed	35	209	3.34
	CL observed	92	212	2.21

## Conclusion

This study showed that the lactation anoestrous status of first-calf cows had only a small effect on the weaning weight of the calf and the effect differed across locations. This suggests that selecting for animals that show a CL while lactating should not result in lower WW. However, the significant interaction between CL and LOC suggests that the environment may be affecting this and further investigation and additional data are required to substantiate this finding.

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MLA MDC funded Repronomics™ project Funding from Queensland government.

<sup>C</sup> Corresponding author: kim.hubbard@dpi.qld.gov.au

# Pasture utilisation that maintains land condition is most profitable long term

Robyn Cowley<sup>A</sup>, Lester Pahl<sup>B,E</sup>, Giselle Whish<sup>B</sup>, Kieren McCosker<sup>C</sup>, Trudi Oxley<sup>D</sup>

<sup>A</sup> Department of Agriculture and Fisheries, Alice Springs, Northern Territory; <sup>B</sup> Department of Primary Industries, Queensland; <sup>C</sup> The University of Queensland, <sup>D</sup> Upriver NT Pty Ltd

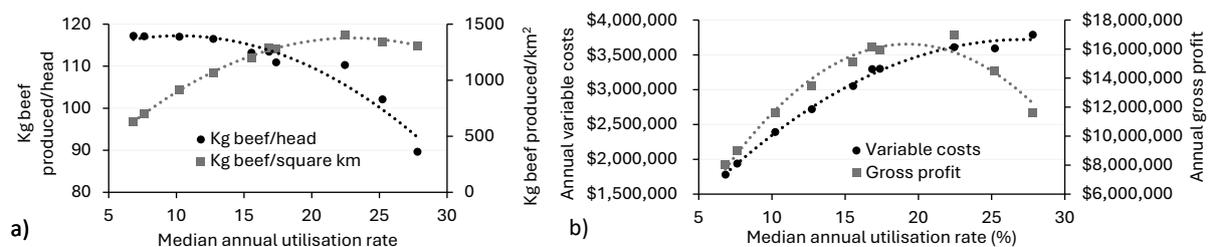
## Introduction

High pasture utilisation in extensive rangelands of Northern Australia leads to short term declines in beef cattle breeder performance (McCosker et al., 2026). But despite lower individual animal performance, in the short term and with good rainfall, higher pasture utilisation leads to higher production and profits. To better understand the longer-term impacts of utilisation with climate variability, we simulated the longer-term impacts of pasture utilisation using historical climate, including how pasture utilisation feeds back to productive potential of the landscape, beef production and profitability.

## Methods

The bioeconomic model CLEM was used to simulate the long-term effects of pasture utilisation in the Burdekin (NE Qld) and Barkly (central eastern NT) regions. Barkly simulation results with Brunette Downs climate are shown in Fig.1, but the discussion below is relevant for both regions' results.

## Results



**Fig. 1. Simulated Barkly representative property average annual beef production per head and per area (a) and variable costs and gross profit (b) vs. median pasture utilisation. Average of 44 years**

## Discussion and conclusion

Simulation results suggest that although higher than recommended pasture utilisation generates higher profits in the short-term, over the longer-term, they lead to poorer land condition, lower pasture productivity, beef production and profits. In both regions, the most profitable breeder herds had the maximum stocking rate possible without causing long-term reductions in land condition. Trying to achieve higher stocking rates in wetter years often led to subsequent overutilisation and land condition decline when drier years returned. The short-term opportunity cost in not utilising occasional large amounts of forage available during periods of high rainfall, was more than repaid by the land condition buffer that limits or even prevents crashes in herd production in the next drought. Without this buffer, costly periods of drought feeding, destocking or high mortality rates were more frequent, and additionally, they limited future herd productivity and profitability.

Results were dependent on the expert-derived model assumptions of rates of land condition change at different thresholds of pasture utilisation. A sensitivity analysis of how these assumptions affect modelled outcomes is recommended to better understand the economics of land condition decline and recovery for extensively grazed systems in Northern Australia.

## Acknowledgment

This study was funded by Meat & Livestock Australia as B.GBP.0029 - The Sweet Spot project.

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McCosker et al., (2026) Proceedings Northern Beef Research Update Conference.

<sup>E</sup> Corresponding author: pahlfirman@bigpond.com

# Seasonal pasture budgeting at property scale – a FORAGE online tool (prototype) for assessing stocking rates for Queensland grazing lands

Baisen Zhang<sup>AD</sup>, Jason Barnetson<sup>A</sup>, John Carter<sup>A</sup>, Grant Fraser<sup>A</sup>, Grant Stone<sup>A</sup>, Luis Woodrow<sup>A</sup>

<sup>A</sup> Queensland Department of the Environment, Tourism, Science and Innovation, Ecosciences Precinct, Dutton Park, Queensland, Australia.

## Introduction

Pasture budgeting is an important grazing land management activity to match livestock demands with available pasture. While many tools and methods are available, land managers often have difficulties in conducting pasture budgeting, as it involves a range of tasks including measuring/estimating current pasture biomass and new growth for the grazing period often across a spatially diverse property/paddocks, as well as estimating intakes of livestock with different animal types and sizes.

A novel online seasonal pasture budgeting prototype tool was developed as part of the existing FORAGE grazing land management information system ([www.longpaddock.qld.gov.au/forage/](http://www.longpaddock.qld.gov.au/forage/)). This budgeting tool only requires users to provide simple information such as property identifier, grazing period (up to 6 months), livestock numbers (as total adult equivalents or herd composition), land condition and a residual biomass or a cover target at the end of the grazing period. The system then conducts a range of modelling, statistical and spatial analyses, and provides a comprehensive seasonal pasture budgeting report by email to users' consideration.

## Methods

In this tool, initial pasture biomass for the nominated grazing period can be user-nominated, estimated from satellite imagery-based machine learning models or estimated using GRASP – a pasture system model. Future pasture biomass estimates for pasture budgeting are then calculated by the GRASP model and satellite-derived estimates for different land types and tree densities across the property/paddock using climate data and soil and pasture parameters sourced from internal/external databases. Model parameters are then optimised/calibrated for the specific location using ground cover data estimated from Landsat images. Pasture growth, detachment, trampling and amount eaten by livestock during the grazing period are also estimated by the GRASP model, using forecasted climate data. Model calibrations are conducted using field measurements and stock records from four central and north Queensland properties with the property families providing valued feedback throughout the product development period.

## Results

The resultant FORAGE report relates whether (or not) the user-defined stock numbers can be supported for the nominated period within the ground cover/pasture biomass residue targets. This includes: descriptive information (input/output pasture, ground cover and grazing capacity values); time series graphs (pasture biomass, grazing days, analogue rainfall years); and property mapping, of indicative pasture biomass.

## Discussion and conclusion

The online pasture budgeting tool as a FORAGE report provides a simple, durable and automated approach for grazing land managers to access free and timely seasonal pasture budgeting information to assist with on-ground stocking rate management in Queensland. The prototype FORAGE report is currently undergoing user testing and enhancements which will inform the availability of the prototype as a component of FORAGE products made available.

<sup>D</sup> Corresponding author: Baisen.Zhang@detsi.qld.gov.au

# Mapping pasture quality: Using remote sensing to address northern Australia's fodder gap

Jason Barnettson<sup>AC</sup>, Hemant Pandeya<sup>B</sup>, Grant Fraser<sup>A</sup>

<sup>A</sup> Queensland Department of Environment, Tourism, Science and Innovation, Dutton Park, 4120; <sup>B</sup> Queensland Department of Primary Industries, Dutton Park, 4120

## Introduction

This study demonstrates how new remote sensing technologies can accurately measure the nutrient status (protein, nitrogen and fibre) of pastures. This is critical knowledge for livestock grazing management, especially with high rainfall variability and a changing climate. With knowledge of both the amount and nutritional quality of pasture (seasonally), graziers can adjust their property or paddock stocking rates and apply supplementation to ensure their operations are both productive and sustainable.

## Methods

Field sampling took place at five commercial properties in Queensland's rangelands, covering both native and introduced grasses at different growth stages. Hyperspectral sensors were used on uncrewed aerial vehicles (UAVs) and from satellites to measure the nutrient content of various pastures. Spectral data was collected at the leaf, plant, and sward levels using both point and imaging systems in the field, laboratory, and from the air. Traditional lab methods were used to analyse the nutrient content of plant leaves and stems and trained a deep-learning neural network model. The model developed was used to predict nutrient content; predictions were then scaled from the plant level to an entire paddock using UAV and satellite imagery. In addition, free-to-access EMIT sensor data from the International Space Station were also used to make predictions over large areas.

## Results

The model's predictions were considered to have good accuracy, with an average error of only two percent for crude protein (CV ~20%) and five percent for fibre content (CV ~5%). By mapping at the property and paddock scale, we were able to discuss the results with collaborators, which facilitated knowledge transfer and the collection of valuable feedback.

## Discussion and conclusion

This study demonstrates the potential to efficiently and accurately map pasture productivity (through nutrient status) over vast areas using remote techniques. A key challenge we encountered was distinguishing tree canopy spectra from pasture spectra, and this area warrants future research. As more airborne and space-borne hyperspectral sensors become available, this technology has the potential to become a standard tool for large-scale pasture management, benefiting the Northern Australia grazing community. Due to livestock mobility and selection at the paddock scale, understanding the livestock nutritional impact of pasture quality variation within a paddock will also require further research.

<sup>C</sup> Corresponding author: [jason.barnetson@detsi.qld.gov.au](mailto:jason.barnetson@detsi.qld.gov.au)

# Adjusting the seasonal persistent green product for green grass signal

Luis Woodrow<sup>A</sup>, Robert Denham, Fiona Watson, Baisen Zhang, John Carter

<sup>A</sup>Queensland Department of the Environment, Tourism, Science and Innovation (DETSI). Ecosciences Precinct, Dutton Park, Queensland, Australia.

## Introduction

While trees play a vital role in functioning grazing land systems (i.e. nutrient cycling, biodiversity), accurately monitoring woody vegetation foliage using remote sensing remains a challenge. One key complication is the presence of green grass beneath trees, which interferes with foliage detection. This paper builds on the Seasonal Persistent Green (SPG) product (DETSI, 2022) by integrating spatial data from the SLATS woody extent (DETSI, 2025) to isolate and remove the persistently green grass signal from the SPG. The result is an adjusted SPG product that better represents tree foliage by excluding the contribution of persistently green grass.

## Methods

Each Landsat satellite scene is processed individually. The scene is spatially clustered and converted into polygons. A time series of SPG (1994–present) is loaded and masked to exclude crops, water, and areas with seasonally persistent non-green >80%. The seasonally persistent non-green is derived using the same method as the persistent green but focuses on the non-green fraction. For each polygon, the following steps are performed:

1. Using the SLATS woody extent, the median SPG of the cleared areas and the mean of the woody areas are calculated within the polygon.
2. A buffer (starting at 5 km and increasing to a maximum of 25 km) is applied to ensure sufficient cleared land for comparison. The mean SPG of the cleared area within the buffer is calculated.
3. The treed area is compared to the cleared area by analysing the differences in their time series and fitting a regression model.
4. The regression is used to reconstruct a time series of persistently green grass, which is then subtracted from the treed time series to isolate tree foliage.

## Results

The distribution for the most recent SPG for Landsat path 94 row 74 is shown in Fig. 1. This is a coastal area with open woodlands and is expected to have a more significant change than other locations. The average reduction for woody and cleared areas were 11% and 14% SPG respectively. For woody areas, the average SPG decreased from 31% to 20%, and for cleared areas 17% to 2%.

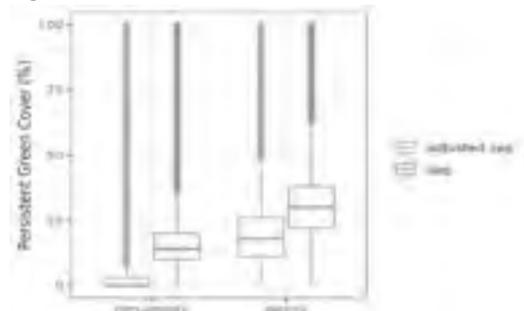


Figure 1 SPG Distribution

## Discussion and conclusion

The resultant regressions from this analysis effectively quantify how much of the SPG variation in treed areas can be attributed to persistently green grass in cleared areas. By removing this grass signal, the adjusted SPG product provides a clearer and more reliable measure of tree foliage, offering valuable insights for improving land management and ecological monitoring.

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<sup>A</sup>Corresponding author: Luis.Woodrow@qld.gov.au

# Cottonseed supplementation of Rhodes grass hay improves growth of Brahman cross steers in the north-east Kimberley

James Dougherty<sup>AG</sup>, Darcy Maccartie<sup>B</sup>, Fiona Anderson<sup>C</sup>, Dominique Blache<sup>D</sup>, Shane Maloney<sup>D</sup>, John Milton<sup>D</sup>, Emma Moore<sup>B</sup>, Hugo Quinn<sup>B</sup>, Graham Gardner<sup>C</sup>, Clinton Revell<sup>E</sup>, Dean Thomas<sup>F</sup>

<sup>A</sup> CSIRO Agriculture & Food St Lucia 4067; <sup>B</sup> DPIRD WA, Kununurra 6743; <sup>C</sup> Murdoch University, Murdoch 6150; <sup>D</sup> The University of Western Australia, Crawley 6009; <sup>E</sup> DPIRD WA, Perth 6000; <sup>F</sup> CSIRO Agriculture & Food, Floreat 6014

## Introduction

In the northern pastoral region of Western Australia (WA), weaner cattle are typically backgrounded on native pasture until they reach sufficient weight (~350 kg) to be sold for live export or entry into a feedlot. However, gains on native pasture in the dry season are often low. Cottonseed has already been used to improve growth and feed efficiency in feedlots, reducing time to market (Meat & Livestock Australia 2008). However, the potential benefits of combining whole cottonseed with forage-based diets for northern cattle genotypes are less understood. This study therefore aimed to determine the value of supplementing Rhodes grass hay with cottonseed in confinement as a cost-effective way to improve liveweight gains of cattle in northern production systems.

## Methods

The study was conducted at the DPIRD Kununurra Research Station in WA, with 72 Brahman cross steers (12/pen, 3 pens/treatment). Steers were randomly assigned to one of two groups and fed either a Control (*ad libitum* Rhodes grass hay) or Treatment diet (Control + 0.5% pen average liveweight of whole cottonseed) for 75 days. Cattle were weighed weekly, and intake and refusals for each pen were recorded daily. Total ration cost per kg dry matter was \$0.45 and \$0.47 AUD for treatment and control diets, respectively. Data were analysed using in R using mixed models and ANOVA.

## Results

Feeding cottonseed improved liveweight gains by ~0.2 kg/hd/day. Control steers had higher average feed intake, but the Treatment steers had higher ME intake due to the higher energy provided by the cottonseed, leading to a better feed conversion ratio and lower cost of gain.

**Table 1. Effect of +/- whole cottonseed feeding on liveweight gain over 75 days.**

	Control	Treatment	Significance (P<0.05)
Final Live Weight, kg	323	332	*
Average Daily Gain, kg/day	0.58	0.77	*
Average Total Dry Matter Intake (DMI), kg/hd/day	7.62	7.29	*
Average Metabolisable Energy (ME) Intake, MJ/hd/day	45.9	57.7	*
Feed Conversion Ratio, kg DMI / kg liveweight gain	13.43	9.43	*
Cost of Gain (\$ feed cost / kg liveweight gain)	6.27	4.25	*

## Discussion and conclusion

These preliminary results indicate that supplementing Rhodes grass hay with whole cottonseed is a cost-effective way of improving performance of *Bos indicus* cross cattle in Northern Australia, which could encourage broader discussion on ways to further improve the efficiency of northern cattle production systems. Further research will explore how cottonseed and other local byproducts could be used to help Northern cattle meet market specifications and improve growth on native pasture.

## References

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<sup>G</sup> Corresponding author: James.Dougherty@csiro.au

# What drives cattle landscape use in Central Australia?

Georgia Anderson <sup>A</sup>, Chris Materne, Robyn Cowley, Ben Wirf, Lakota Taber

Northern Territory Department of Agriculture and Fisheries, Alice Springs 0870

## Introduction

Cattle landscape use in Central Australia is strongly influenced by distance from water, but other factors influencing how far animals travel and how evenly they graze remain less well known in commercial sized paddocks. Carrying capacity methodologies rely on assumptions about watered area that have not been tested with local data in Central Australia. To collect data specific to Central Australia, GPS collars were deployed on cattle across multiple paddocks with varying levels of pasture utilisation to examine how cattle are using the landscape.

## Methods

Across nine paddocks on four stations in Central Australia, cattle were tracked every 10 minutes using 300 Global Navigation Satellite System (GNSS) collars between July 2023 and May 2024 under Animal Ethics Committee approval. Each paddock had 20 animals per class fitted with GNSS devices, which were rotated every four months depending on station activities and collar battery life. The GNSS data were used to assess the effect of different factors on grazing behaviour. Data within 150m of a waterpoint were excluded to remove time spent by animals camping at watering points. Pasture utilisation (grazing pressure) was modelled using the Cowley and Walsh (2023) methodology. This study was part of the Future Drought Fund's Rain Ready Rangelands Project.

## Results

Where pasture utilisation rates were low (5–15%), cattle spent greater than 70% of time within 3km and 90% within 4km of a water point. When pasture utilisation was medium to high (>15%), only 50% of time was spent within 3km and 50% of time spent within 4km of watering points.

**Table 1. Summary of time spent in relation to distance from water.**

Class	Number of collars deployed (- not recovered)	Pasture Utilisation (%)	Time (%) Distance from Water			
			<3km	3-4km	4-5km	>5km
Breeder	<i>n</i> = 46 - 7	5-10	75	13	4	7
Steer	<i>n</i> = 58 - 17	5-15	77	13	6	4
Breeder	<i>n</i> = 13 - 3	5-15	70	13	10	7
Steer	<i>n</i> = 16 - 3	15-30	45	33	14	9
Breeder	<i>n</i> = 36 - 12	25-40	51	12	10	28
Steer	<i>n</i> = 17 - 14	25-40	50	13	9	27

## Discussion and conclusion

The data demonstrated that cattle landscape use is strongly influenced by the watered area of a paddock and supports the Long-Term Carrying Capacity (LTCC) methodology. Paddock size had little influence on cattle movement from water. In both South Stuart paddock (26 km<sup>2</sup>) and the Night paddock (2960 km<sup>2</sup>), 80% of time was spent within 3 km of water and less than 1% beyond 5 km at similar utilisation rates of 5–15%. Findings showed cattle walked further under higher utilisation rates, using more energy which may reduce production performance. Cattle class, pregnancy, coat colour and season did not significantly affect the time spent at varying distances from water. Despite a small sample size, the project offers insight into pasture utilisation rates and the effect on distance travelled from water.

## References

Cowley R, Walsh D (2023). Northern Territory Government, Technical Bulletin No. 360.

<sup>A</sup> Corresponding author: georgia.anderson@nt.gov.au

# Bluetooth ear tags can help track supplement intake in grazing cattle

Tamara Freitas-Kirk, Karen Eyre, Kieren McCosker, Luis Prada e Silva<sup>A</sup>

Queensland Alliance for Agriculture and Food Innovation, The University of Queensland, Gatton, QLD 4343

## Introduction

In northern beef systems, supplements are often used to lift productivity. But not all animals eat the same amount, some eat too much, others hardly touch it, which reduces the efficiency of the program and increases costs (Dixon et al., 2017). Current monitoring methods look only at the herd level. This project tested whether Bluetooth ear tags could provide a simple, low-cost way to track how much time individual animals spend at a feeder, and whether this information can be used to estimate supplement intake of individual cattle.

## Methods

Fourteen Droughtmaster heifers (268 ± 33 kg) grazed a 10-ha paddock at UQ Gatton. They were offered protein supplements in two phases: a low-intake product designed for approximately 300 g/head/day, followed by a higher-intake product designed for approximately 1 kg/head/day. Each animal was fitted with a Bluetooth ear tag containing an activity sensor (WelfareTag™, HerdDogg, Seward, Nebraska, USA). A Bluetooth receiver placed near the feeder recorded which cattle were present every 30 seconds and the strength of their signal, while video cameras provided the reference data to evaluate the accuracy of the system.

## Results

Analysis showed that applying a signal strength threshold of -50 dBm to the Bluetooth data provided the closest match to observed feeder visits, and accuracy improved further when activity data from the ear tags were included. The combined model explained about 70% of the variation in time spent at the feeder. Average daily cumulative time that animals spent at the feeder was about six minutes, but substantial differences between animals existed. Variation in estimated supplement intake was high, with a coefficient of variation of 26% in the first feeding period and 14% in the second.

**Table 1. Observed versus predicted supplement intake of heifers, using Bluetooth ear tags and activity data.**

Item	Observed (video + refusals)	Predicted (Bluetooth + activity)	Agreement
Mean intake (g/day)	280 (low) – 640 (high)	278 (low) – 638 (high)	–
Range (g/day)	143 – 829	150 – 810	–
Model accuracy (R <sup>2</sup> adj)	–	–	0.70
Concordance correlation	–	–	0.83

## Discussion and conclusion

Bluetooth ear tags offered a reliable and practical way to measure supplement consumption at the individual animal level. The study demonstrated that this technology could identify both shy feeders and over-consumers, improve the efficiency of supplementation programs and reduce waste. It also provides a foundation for future use of feed additives, where consistent intake across all animals will be essential. For producers, Bluetooth tags represent a scalable tool to fine-tune supplement programs, save costs and improve herd performance.

## References

Dixon RM, Anderson A, Petherick JC (2017). *Animal Production Science* 57, 315–319.

<sup>A</sup> Corresponding author: l.pradaesilva@uq.edu.au

# FireGraze: Using strategic patch burning to influence cattle grazing behaviour and improve land condition

Gretel Bailey-Preston <sup>A,C</sup>, Caroline Pettit <sup>B</sup>, Ben Wirf <sup>B</sup>

<sup>A</sup> NT Department of Agriculture and Fisheries, Katherine 0850; <sup>B</sup> NT Department of Agriculture and Fisheries, Berrimah Farm 0800

## Introduction

Overgrazing of productive land types within a paddock can lead to a decline in soil health and palatable plant species leading to an overall reduction in land condition. One way to manage grazing within a paddock is to burn underutilised parts of a paddock which will attract cattle to these areas due to the high protein post-fire regrowth (Reid 2022). The aim of this trial is to investigate if burning these less preferred areas will promote more even utilisation of a paddock and increase productivity.

## Methods

In December 2023 a 3.3 km<sup>2</sup> area (15% of paddock) of underutilised red earths was burnt at Victoria River Research Station, NT in a paddock that contained a mix of red earths and black soils. The paddock was stocked to its long-term carrying capacity and 25 randomly selected cows were fitted with GNSS collars which were downloaded twice a year at each muster in May and September. GNSS data was analysed to calculate time spent in different areas of the paddock.

## Results

Figure 1 shows a significant increase in time spent in the burnt red earth areas immediately after the fire with a corresponding reduction in grazing pressure on the black soils. The effect was short term, with cattle returning to the preferred black soils as pasture matured.

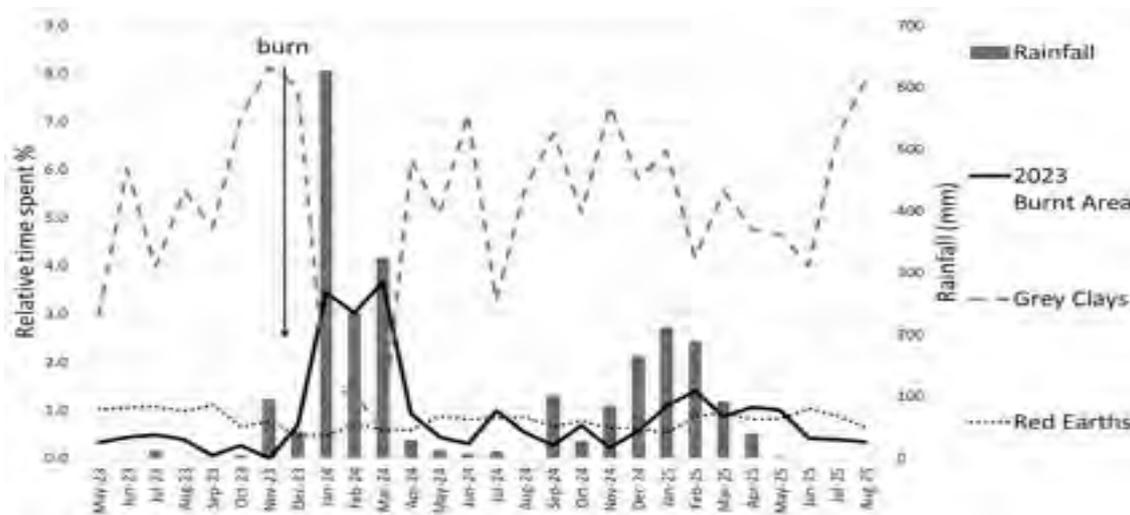


Figure 1. The relative time spent in different areas of Box paddock.

## Discussion and conclusion

These results indicate that strategic patch burning can temporarily redistribute grazing pressure to rest heavily grazed areas despite strong land type grazing preferences. In the following wet season, when no burning occurred, there was no comparable change in grazing distribution on the red and black soil. 2023/24 was a high rainfall year, so further research is required to understand the impact of seasonal conditions.

## References

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<sup>C</sup> Corresponding author: gretel.baileypreston@nt.gov.au

# Zero Net Emissions from a thriving Australian agriculture sector

*Richard Heath<sup>A</sup>*

Zero Net Emissions Agriculture CRC. Building 20, Staff House Road, The University of Queensland,  
St Lucia, QLD 4072

## Introduction

Zero Net Emissions Agriculture CRC is committed to bridging the gap between scientific discovery and practical, on-farm application. It was established in July 2024 under the Australian Government's Cooperative Research Program to reduce emissions across Australian agriculture and formed through a collaborative partnership between leading research organisations, industry bodies, companies, and government agencies. The ZNE-Ag CRC will help position Australian agriculture as a key player in the global transition to a lower emissions future, making a meaningful contribution to both national and international climate goals.

## Tools and technology

The CRC is focused on developing tools and technologies to lower emissions and empower Australian farmers and land managers to make climate-conscious decisions while driving productivity on farm. Research projects are underway across four key programs.

1. Low emissions plant solutions
2. Towards methane-free cattle and sheep
3. Whole farm and mixed enterprise systems analysis
4. Delivering value from net zero

Research projects include methane-reducing technologies, advancing low-emissions fertilisers and nitrogen solutions and integrating whole-farm systems modelling into real-world decision making. The projects are driving practical solutions that reduce emissions while strengthening productivity. Key projects addressing the challenge of methane produced primarily by livestock, is:

- Project 1010: Northern Australia low methane feedbase program – phase 1
- Project 1021: High performance methane-mitigating pastures for the ovine industry
- Project 1020: Feedbase solutions to reduce enteric methane in Southern Australia
- Project 1030: Low emissions grasses for cattle feed
- Project 2010: Proxies for ruminant methane emissions
- Project 2030: Biodegradable solutions for low emissions livestock

Each of these research programs is supported by a nationwide network of up to 25 producer demonstration sites, where new and innovative technology is tested at scale. These sites allow the CRC to compare, stack and de-risk new technologies, practices and products to support the industry's transition to a lower emissions future. Building a diverse, multidisciplinary, future-ready workforce with the necessary skills and knowledge to manage the country's transition to a lower emissions future is a key focus for the CRC. This will be achieved through the delivery of an Indigenous Academy, PhD training and education modules.

The CRC will research and develop new technology and innovative solutions to meet the significant challenge of emissions reduction. The research undertaken will ensure practical outcomes for the farm and the planet.

<sup>A</sup>Corresponding author: rheath@zneagcrc.com.au

# From weaning to research ready: enhancing Greenfeed Emissions Monitoring (GEM) unit interaction in extensive grazing systems

Melissah Dayman <sup>A</sup>

Department of Primary Industries, Gayndah 4625

## Introduction

Voluntary engagement with Greenfeed Emissions Monitoring (GEM) units remains a significant challenge in extensive grazing systems (Hegarty 2019), often leading to prolonged induction periods and limited methane emissions data capture. This pilot study explored whether early-age training of weaned heifers could increase GEM unit utilisation, improve data accuracy, and establish a research-ready cohort for methane-related projects at the Brian Pastures Research Facility.

## Methods

Ninety-six Brahman, Droughtmaster and Santa Gertrudis weaner heifers were randomly assigned to trained and control groups (two pens per group, 24 animals per pen) in June 2024. Training involved operant conditioning, using auditory cues paired with lucerne pellet rewards over a 7-day period. Feeders were progressively modified to simulate GEM units. Daily 15-minute observations recorded feeder approach, response to cues, and feeding behaviour.

In January 2025, the heifers participated in a larger methane trial, where they had access to four GEM units, in a 175 ha paddock. Due to project constraints treatment groups could not be separated during this phase however, engagement data was still collected for a period of 21 days during the standard training period.

## Results

By Day 7 of the pilot trial, 92% of animals in the trained group, T2, responded positively to auditory cues, with 50% approaching and feeding at the enclosed bunks during the observation period. In contrast, the second trained group, T1, showed a 79% positive response, with 37.5% approaching and feeding. The lower response in T1 was attributed to temporarily reduced feeder access.

In the subsequent 2025 trial, 87% of trained animals voluntarily utilised the GEM units on Day 1 of exposure, compared to 44% of the untrained cohort. By Day 10, daily GEM unit usage was 80% in the trained cohort, while the untrained cohort reached 55%.

## Discussion and conclusion

The results suggest that early-age training during weaning increased GEM unit voluntary engagement and usage. Trained animals exhibited greater familiarity and confidence with the units from Day 1 in a subsequent trial 7 months later, visiting more frequently and consistently.

Further research is required to validate this initial trial on the direct impact of early-age training on GEM unit engagement at a larger scale. Additional work would also provide an opportunity to investigate herd social learning as a complementary mechanism to improve the efficiency of methane data capture in extensive grazing systems. By refining training methods and leveraging social learning, it may be possible to reduce the resources required for induction while enhancing the scalability and accuracy of methane measurement practices.

## References

Hegarty R (2015) B.CCH.6230 Evaluation and optimisation of GEM units for livestock, MLA Final Report

<sup>A</sup> Corresponding author: melissah.dayman@dpi.qld.gov.au

# Methane emissions from cattle grazing *Desmanthus* pastures on property

Melissa Matthews <sup>A,D</sup>, Ed Charmley <sup>A</sup>, Lachlan Godson <sup>B</sup>, Zac Geldof <sup>B</sup>, Chris Gardiner <sup>C</sup>, Nick Kempe <sup>B</sup>

<sup>A</sup> CSIRO, PO Box 145, James Cook University, Qld, 4811; <sup>B</sup> Agrimix Pty Ltd, PO Box 195, Ferny Hills DC, Qld 4055;

<sup>C</sup> James Cook University, Townsville, Qld 4811

## Introduction

*Desmanthus* is a tropical legume often incorporated into native pastures to improve the available protein levels and increase productivity in the dry season and may also result in decreased methane emissions. This long-term study was initiated to determine if *Desmanthus* could decrease methane emissions while improving productivity in grazing cattle throughout their growth period.

## Methods

The project was located on Cungelella Station (24.66° south, 147.21° west), chosen for its similarity to a substantial proportion of beef properties in Queensland. Four replicated paddocks of approximately 300 ha each were created on cleared brigalow country, 2 control paddocks and 2 treatment paddocks (Fig. 1.). The control paddocks were dominated by Buffel grass (*Cenchrus ciliaris*). The treatment paddocks contained Buffel with approximately 30% Progardes® *Desmanthus*.

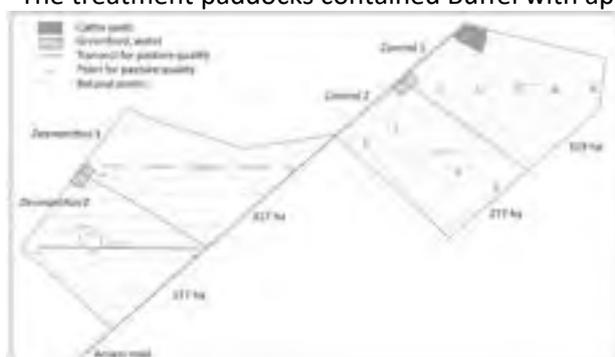


Fig. 2. Layout of the replicated paddocks.

The trial spanned 2 wet seasons and a dry season, over 16 months. Pasture Botanalys were conducted every 2-4 months and a gas emission monitoring (GEM) unit was deployed to each paddock to measure enteric methane emissions throughout the trial. Stocking rates were set at 100 head per paddock and ~30 animals from each paddock were allowed access to the GEM units. Faecal samples were taken throughout the trial to determine diet composition and liveweights (LW) were recorded to measure LW gain.

## Results

Liveweight gain was greater for the *Desmanthus* animals, particularly during the wet seasons (Table 1). Significant differences in methane production due to treatment were not apparent, but seasonal effects could be seen throughout the wet season months. Adjusting emissions for estimated dry matter intake (DMI) or LW produced significant treatment effects on yield and intensity (Table 1).

Table 1. Liveweight gain (LWG), methane (CH<sub>4</sub>) data & pasture nutritive values.

	Control		Desmanthus		s.e.	P =		
	Wet	Dry	Wet	Dry		TRT	Seaso	T x S
LW gain (kg/d)	0.77	0.43	0.84	0.36	0.03	0.951	<0.001	0.058
CH <sub>4</sub> production	199	159	186	165	3.59	0.324	<0.001	0.005
CH <sub>4</sub> yield (g/kg DMI)	30.1	23.9	27.6	24.7	0.55	0.100	<	0.004
CH <sub>4</sub> intensity (g/kg)	0.52	0.41	0.48	0.41	0.00	0.036	<	0.004
DM digestibility (%)	58.9	53.0	58.7	52.4	0.16	0.019	<	0.193
Non grass (%)	22.8	21.6	31.8	19.5	0.74	<	<	<

## Discussion and conclusion

There was a marked seasonal effect on performance and emissions with higher performance and lower methane in the wet seasons. Methane production was not influenced by treatment however methane yield and intensity were reduced by *Desmanthus* in the diet.

<sup>D</sup> Corresponding author: melissa.matthews@csiro.au

# Advancing faecal NIRS for predicting intake and methane emissions from northern cattle herds

Hayley Norman <sup>AB</sup>, Elizabeth Hulm <sup>A</sup>, Joshua Hendry <sup>A</sup>, Ed Charmley <sup>C</sup>

<sup>A</sup> CSIRO Agriculture & Food, Floreat, WA , 6018., <sup>C</sup> CSIRO Agriculture & Food, Townsville, QLD, 4811

## Introduction

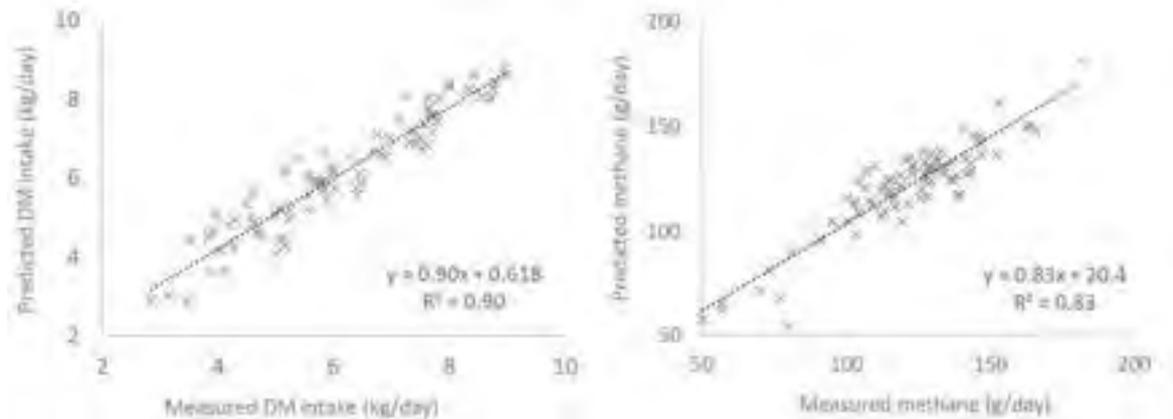
Near Infrared Reflectance Spectroscopy (NIRS) is a rapid and inexpensive technology used to assess the nutritive value of ruminant feeds. The late David Coates and colleagues were instrumental in developing foundational faecal NIRS calibrations to assess digestibility and crude protein content for the diets typical of northern cattle (Coates and Dixon 2011). Our goal was to test and validate the technique to predict intake and methane emissions against a data base from in vivo studies.

## Methods

Ninety dried and ground faecal samples collected from cattle experiments at CSIRO's Lansdown Research Station from 2018 to 2020 (Suybeng et al., 2021; Stifkens et al., 2022) were scanned with a desktop NIRS (Unity Spectrastar 2600XTR). Diets included a range of subtropical grasses, Desmanthus, Leucaena and Lucerne. Statistical relationships were developed between enteric methane emissions data from open circuit respiration chambers and light absorbance (700 – 2500 nm).

## Results

Regressions of measured and predicted intake and methane emissions were determined for the 90 faecal samples. The digestible DMI (kg/d) was predicted with an R<sup>2</sup> of 0.90 and mean error of 0.43 kg (Fig. 1). Enteric methane emissions were predicted with an R<sup>2</sup> of 0.83 and mean error of 8.3 g/day.



**Fig 1. Predicted and measured dry matter intake (kg/day) and methane emissions (g/day).**

## Discussion and conclusion

There is a significant opportunity to develop NIRS calibrations to predict intake, methane (daily production and yield) and the nutritional value of the diet selected by the animal. Moving from dry and ground samples in a laboratory, to wet unground samples in the field remains a challenge due to errors generated by moisture content, sample heterogeneity and ambient light. We are investigating expansion of the faecal NIRS commercial calibrations to include new traits. This will broaden the use of NIRS to encompass southern cattle and sheep. Work with the Global Methane Hub will also develop methane and intake calibrations for dairy cattle in developing countries.

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<sup>B</sup> Corresponding author: Hayley.Norman@csiro.au

# Measuring methane emissions under grazing conditions in Brahman heifers

Marina RS Fortes<sup>A,B</sup>, Alana C Boulton<sup>A</sup>, Andrea N Lopez<sup>A</sup>, Pedro Guerreiro<sup>C</sup>, Manasvinya Madhuprakash<sup>A</sup>, Elizabeth Ross<sup>D</sup>, Diogo FA Costa<sup>C,E</sup>

<sup>A</sup> The University of Queensland, SCMB, QLD 4072; <sup>B</sup> CSIRO Agriculture and Food, QLD 4067 <sup>C</sup> CQUniversity, Institute of Future Farming Systems, SHMAS, Rockhampton, QLD 4701 <sup>D</sup> QAAFI Centre for Animal Science, St Lucia, Brisbane, Qld 4072, Australia. <sup>E</sup> ESALQ/USP, Piracicaba, SP, Brazil 13418900

## Introduction

The beef industry must create an inventory of enteric methane (CH<sub>4</sub>) emissions under Australian production systems to estimate its carbon footprint. To represent an important animal category, we measured enteric CH<sub>4</sub> in 10 Brahman heifers, 5 of which were 263 days pregnant. In this cohort, 50% of animals successfully carried their first pregnancy to term, after 1 mating season.

## Materials and methods

Animal ethics was obtained as part of a larger project studying a low emissions saliva test for ruminants (*LESTR*, certificate 2022/AE000438). Heifers were managed under grazing conditions at the Gatton Campus facility on Rhodes grass pastures. The SF<sub>6</sub> tracer gas methodology was used to measure enteric CH<sub>4</sub> emissions (Deighton et al., 2014). Heifers were measured over 5 consecutive days. Yttrium chloride served as an internal marker of faecal output (Davies and Gouveia, 2006) to estimate dry matter intake (DMI). Pasture nutritional quality and faecal samples were analysed (Table. 1).

## Results and discussion

Estimated mean CH<sub>4</sub> production was 293.50 ± 40.69 g/d or 21.57 g/d per kg DMI (Table 1). The yttrium chloride curve allowed for the calculation of faecal output per day (Fig 1).

Table 1. Mean measurements and estimates

10 Heifers	MEAN	SEM	Min	Max
Bos indicus %	0.86	0.03	0.63	0.95
LW (kg)	498.40	5.31	470.00	526.00
CH <sub>4</sub> g/day	293.50	40.69	145.77	468.64
Faecal NDFD%	66.29	0.71	62.51	70.26
Faecal Ash%	21.05	0.52	18.98	23.55
Faecal iNDF%	37.26	0.95	33.49	43.60
Dry Matter Digest.%	55.67	1.09	50.74	62.34
NDF Digest. Avg.%	66.29	0.71	62.51	70.26
Organic Matter Digest.%	61.49	1.00	57.20	68.33
Faecal Output DM (kg/d)	6.03	0.42	4.31	7.77
Dry Matter Intake (kg/d)	13.61	0.87	8.96	17.26

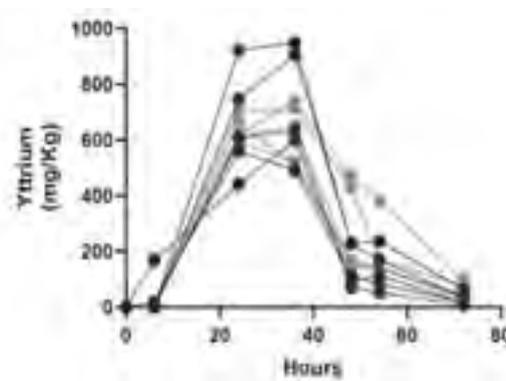


Figure 1. Faecal YCl<sub>3</sub> (mg/kg) for pregnant (●) and non-pregnant (□) brahman heifers

Recording enteric CH<sub>4</sub> emissions and estimating DMI on pasture are essential for improving accuracy in grassfed livestock carbon inventories. Our data estimates that breeding Brahman heifers grazing tropical pasture emit on average 293.50 g of CH<sub>4</sub>/d, per animal. Accurate national accounting of enteric CH<sub>4</sub> emissions will inform mitigation strategies that fit Australian livestock systems.

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<sup>B</sup>Corresponding author: m.fortes@uq.edu.au

# Discovering Northern Australia's low methane feedbase potential

Diane Ouwerkerk<sup>A,B,K</sup>, Paul Stewart<sup>A</sup>, Steven Bray<sup>A</sup>, Ros Gilbert<sup>A,B</sup>, Maree Bowen<sup>A</sup>, Zoey Durmic<sup>C</sup>, Clinton Revell<sup>D</sup>, Caroline Pettit<sup>E</sup>, Robyn Cowley<sup>E</sup>, Natasha L. Hungerford<sup>B</sup>, Beth Penrose<sup>F</sup>, Iman Tahmasbian<sup>A</sup>, Jing Wang<sup>A</sup>, Jenny Gravel<sup>A</sup>, Anita Maguire<sup>A</sup>, Sophia Escobar Correias<sup>A</sup>, Melissa Dayman<sup>A</sup>, Kerry Goodwin<sup>A</sup>, David Mayer<sup>A</sup>, Nicole Spiegel<sup>A</sup>, David Reid<sup>A</sup>, Stuart Buck<sup>A</sup>, Brett Knight<sup>A</sup>, Gregor McCauley<sup>A</sup>, Sarah Meale<sup>G</sup>, Greg Leach<sup>H</sup>; Wes Lawrence<sup>I</sup>; Dan Chapman<sup>J</sup>

<sup>A</sup>Department of Primary Industries, Dutton Park 4102; <sup>B</sup>Queensland Alliance for Agriculture and Food Innovation, University of Queensland, Coopers Plains 4108; <sup>C</sup>School of Animal Biology, University of Western Australia, Crawley 6009; <sup>D</sup>Department of Primary Industries and Regional Development, Western Australia, Perth 6000; <sup>E</sup>Department of Agriculture and Fisheries, Katherine 0851; <sup>F</sup>Faculty of Science & Technology, Charles Darwin University, Casuarina 0810; <sup>G</sup>School of Agriculture and Food Sciences, University of Queensland, Gatton 4343; <sup>H</sup>AgCarE and Industry Engagement, AgForce Queensland Farmers Ltd, Brisbane 4000; <sup>I</sup>AxisTech Pty Ltd, Osborne Park 6017; <sup>J</sup>AACo Innovation Pty Ltd, Brisbane 4001

## Introduction

Extensive grazing systems constitute > 90% of ruminant livestock production in Northern Australia but lack mitigation technologies applicable to the scale and management practices required for these operations. Previous research has identified *in vitro*, plant species with the potential to reduce methane emissions from grazing cattle and improve animal performance (Durmic *et al.*, 2022). The Northern Australia Low Methane Feedbase Program is a national research initiative within the Zero Net Emissions Agriculture Cooperative Research Centre aiming to develop solutions to reduce enteric methane emissions in extensive grazing livestock and to identify, develop and progress low methane pasture systems in Northern Australia. The program involves collaboration between government agencies, universities, and industry partners from Queensland, Western Australia and the Northern Territory.

## Methods

The project commenced mid-2025 with a comprehensive review of published literature to first identify target plant genera and species of interest. The establishment phase has progressed to prioritising agro-ecological zones across Northern Australia, identifying sites and plants for field collection and standardising methodologies. Field collection of plants will focus on species that can be integrated into extensive grazing systems to lower methane emissions significantly and will be conducted across multiple sites in Queensland, Northern Territory, and Western Australia, ensuring coverage of diverse agro-ecological zones. Collected plant samples will be screened by the DPI Qld and UWA for anti-methanogenic properties using *in vitro* fermentation assays. Variability in methanogenic potential as affected by spatial, temporal and eco-physiological factors will also be assessed by repeated collection of the same plant species at alternative sites and across seasons. Collected plants will also undergo hyperspectral imaging for spectral libraries and employed in the development of artificial intelligence models for AgTech prototypes for feedbase quantitation.

## Discussion

With the majority of Australian ruminant livestock maintained in extensive grazing systems, understanding and ensuring the availability of palatable forage species with anti-methanogenic properties is an important strategy for achieving emission reduction targets.

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<sup>K</sup> Corresponding author: Diane.Ouwerkerk@dpi.qld.gov.au

# Legume-enhanced pastures with fertiliser inputs improve productivity and reduce net GHG emissions in a Central Queensland beef system

L Godson<sup>A</sup>, Z Geldof, Z Mirsafi, and N Kempe

Agrimix Pty Ltd, PO Box 352, Virginia, Qld 4014, Australia.

## Introduction

Pasture rundown and greenhouse gas emissions constrain Northern Australian beef systems, and while deep-rooted legumes can improve productivity and soil carbon (Rowlings et al., 2025; Gardiner 2016), commercial-scale evidence integrating productivity, profitability and emissions remains limited (Rowlings et al., 2025; Gardiner 2016). This study presents results from 6 years of observational data (2019–2025) on a commercial Central Queensland trade cattle property, comparing livestock performance in a Buffel grass (*Cenchrus ciliaris*) paddock (control) with a paddock improved in 2019 using a multi-species mix of Bambatsi (*Panicum coloratum*), Gatton panic (*Megathyrsus maximus*), Caatinga stylo (*Stylosanthes seabrana*) and Progardes<sup>®</sup> (*Desmanthus* spp.). Strategic fertiliser use, particularly phosphorus, was applied to support legume establishment and optimise pasture performance. Performance was assessed through liveweight gains, per-hectare profitability, greenhouse gas emissions, soil carbon sequestration and net emissions intensity. Soil carbon dynamics were monitored using the Agrimix Flux biogeochemical model (DayCent-CABBI) calibrated for the Brigalow Bioregion using eddy covariance flux tower data (Takeda et al., 2025).

The improved system generated an additional 38,215 stock days and increased average daily gain (ADG) by 0.12 kg/day. This translated to a liveweight (LW) yield of 133 kg/ha/year compared to 52 kg/ha/year under the control. Revenue per hectare increased by 181%, equating to \$241–\$286/ha/year depending on market price (\$2.90–\$3.50/kg LW). Using Agrimix Flux model, the improved pasture demonstrated an average sequestration of 0.52 t C/ha/year (1.9 t CO<sub>2</sub> equivalent/ha/year). Over 5 years, this resulted in 9.5 t CO<sub>2</sub>e/ha sequestered versus 7.05 t CO<sub>2</sub>e/ha emitted, achieving a net reduction of 4.2 kg CO<sub>2</sub>e per kg LW produced when grazing the improved pasture paddock.

These findings provide evidence that integrating legumes with strategic fertiliser use not only improves animal performance but also reduces the net greenhouse gas footprint of beef production systems. The net positive carbon balance indicates potential for generating Australian Carbon Credit Units (ACCUs) or insetting value. This long-term, commercially derived dataset supports broader adoption of improved pasture systems in Central Queensland and similar environments, offering a practical and profitable climate resilience strategy for livestock producers.

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## Acknowledgement

This project was funded in part through the MLA Carbon Storage Partnerships research with co-investment from Agrimix Pty Ltd. The Agrimix Flux project received grant funding from the Australian Government's National Soil Carbon Innovation Challenge.

<sup>A</sup>Corresponding author. Email: lachlan.godson@agrimix.com.au

# Controlled-release technology for methane mitigation in grazing beef cattle: 3-nitrooxypropanol (3-NOP) release profiles in water

Céline Chaléat <sup>A, E</sup>, Natasha L. Hungerford <sup>B</sup>, Vivienne S. Santiago <sup>B</sup>, Diane Ouwerkerk <sup>B, C</sup>, Rosalind Gilbert <sup>B, C</sup>, Sarah Meale <sup>D</sup>, Mariano Parra <sup>D</sup>, Steven Pratt <sup>A</sup>, Paul Lant <sup>A</sup>, Mary T. Fletcher <sup>B</sup>, Bronwyn Laycock <sup>A</sup>

<sup>A</sup> School of Chemical Engineering, UQ, St Lucia 4072; <sup>B</sup> QAAFI, UQ, Coopers Plains 4108; <sup>C</sup> Department of Primary Industries, Dutton Park 4102; <sup>D</sup> SAFS, UQ, Gatton 4343

## Introduction

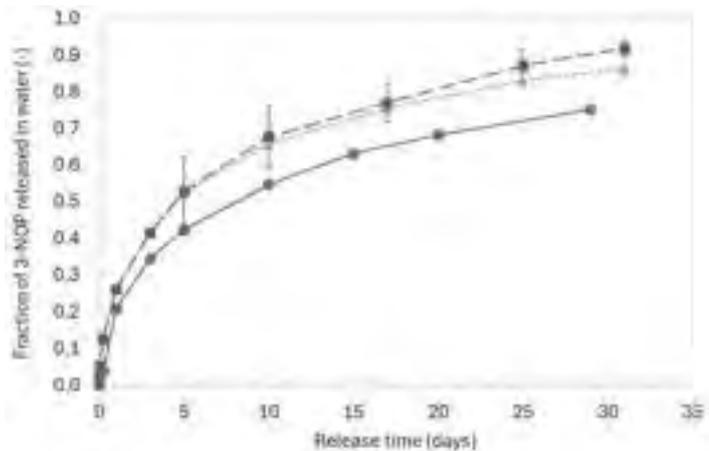
The generation of greenhouse gases from agricultural practices is an increasingly important global issue, with enteric fermentation by ruminant livestock contributing 88% of methane emissions (FAO, 2022). The inhibitor 3-nitrooxypropanol (3-NOP) targets the final step of methanogenesis and effectively suppresses methane production (Duval & Kindermann, 2012). However, frequent supplementation presents barriers to adoption in extensive grazing systems. Controlled-release technology has the potential for application in long-term methane mitigation management strategies. This work investigates the feasibility of a novel controlled-release system for 3-NOP.

## Methods

Disc-shaped biopolymer prototypes containing 3-NOP were manufactured. Release studies were conducted at 39 °C with samples submerged in water and sampled over a 31 d period. Released 3-NOP was quantified using high-performance liquid chromatography with photodiode array detection (HPLC-PDA). Residual 3-NOP present in the biopolymer matrix after one month of release was assessed via Nuclear Magnetic Resonance (NMR) spectroscopy.

## Results

The controlled-release formulations demonstrated promising release behaviour in water, with 3-NOP mobilising from the biopolymer matrix and releasing into the surrounding aqueous phase (Fig 1). The type of biopolymer matrices and 3-NOP loading used influenced the release profile, but release rates from the biopolymer/3-NOP prototypes are within the effective dosage range.



**Fig 1. Fraction of 3-NOP released from biopolymer/3-NOP discs. Biopolymer 1 / 3-NOP A%, Biopolymer 1 / 3-NOP B%, Biopolymer 2 / 3-NOP A%**

## Discussion and conclusion

These findings confirm that controlled release devices can provide sustained bioactive kinetics in aqueous environments, supporting the potential translation to rumen conditions. Ongoing research will progress to *in vitro* rumen simulations and *in vivo* cattle studies. This technology could enable broad adoption in grazing systems across Northern Australia, contributing to emissions reduction goals.

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<sup>E</sup> Corresponding author: c.chaleat@uq.edu.au

# Use of Bovaer in drinking water for Northern Australian cattle

Gonzalo Martinez-Fernandez<sup>A,E</sup>, Aaron Ingham<sup>A</sup>, Melissa Matthews<sup>B</sup>, Neil Bagnall<sup>A</sup>, Reza Arablouei<sup>C</sup>, Brendan Do<sup>C</sup>, Joseph McGrath<sup>D</sup>, Nicola Walker<sup>D</sup>, Maik Kindermann<sup>D</sup> and Stuart Denman<sup>A</sup>

<sup>A</sup>CSIRO, St Lucia, QLD 4067; <sup>B</sup>CSIRO, Townsville, QLD 4811, <sup>C</sup>CSIRO, Pullenvale, QLD 4072; <sup>D</sup>DSM-Firmenich, Kaiseraugst, 4303

## Introduction

Grazing cattle dominate the Australian beef sector. To achieve lower carbon emissions and secure future market access, it is essential to develop effective methods for delivering anti-methanogenic compounds to these animals. Recently, 3-nitrooxypropanol (3-NOP, or Bovaer<sup>®</sup>) has been developed as a feed additive for ruminants to inhibit enteric methane production. Novel ways of delivering the compound to grazing cattle under extensive conditions are currently under development, such as water delivery. This study evaluated the effectiveness of water-based delivery for 3-NOP in decreasing methane emissions from grazing cattle.

## Methods

Sixty *Bos indicus* steers (287 ± 15.1 kg) grazing tropical pastures at Lansdown Research Station (QLD, Australia) were allocated to 2 treatment groups: control (no 3-NOP supplementation) or 3-NOP (target 30 mg 3-NOP /L water, equivalent to 2.5 mg 3-NOP/kg body weight). The study was conducted over a 60 day period in 4 independent replicated paddocks. Four Smartdosing+ units were used to deliver the treatments through drinking water and quantify herd-level water intake. Methane and H<sub>2</sub> emissions were measured using 4 GreenFeed units (C-Lock Inc., Rapid City, USA). Each animal was fitted with an eGrazor collar with tri-axial accelerometer and a Global Navigation Satellite System receiver to monitor and analyse individual behaviour and location.

## Results

The inclusion of the 3-NOP in drinking water had no significant effect on body weight compared with the control group ( $P > 0.05$ ). Methane and hydrogen production from animals receiving the treatment through drinking water were significantly different to control animals ( $P \leq 0.05$ ). Methane production was reduced by up to 27% while hydrogen emissions increased by up to 5.4-fold in treated animals when the target dose of 2.5 mg/kg LW/d was delivered. The mean methane reduction for the whole trial was 15% compared with the control, producing 125.65 g /d of CH<sub>4</sub> which was significantly decreased by 22.12 g / d compared with the control groups 147.78 g / d ( $p < 0.001$ ), with an average dose of ~2 mg/kg LW. Accelerometer data collected from the eGrazor collars was used to classify individual cattle behaviour at each five-second interval as grazing, ruminating, resting, walking, drinking or other. The typical behaviour profile for cattle included two intensive periods of grazing from 05:00- 08:00 and then 15:00 – 19:00. The period outside of the grazing peaks is largely characterised by ruminating and resting behaviours. Peak drinking behaviour was observed at 07:00, 11:00 and 15:00, typically associated with grazing periods.

## Discussion and conclusion

This study demonstrated that Bovaer<sup>®</sup>, can be effectively administered to grazing cattle via drinking water under pastoral conditions in Northern Australia. The results confirm that when cattle consistently receive the targeted dose of 3-NOP ( $\geq 2.5$  mg 3-NOP/kg LW/d), significant reductions in enteric methane emissions of up to 27% can be achieved. The observed variability in methane reduction was associated with natural fluctuations in water intake leading to variations in 3-NOP ingestion by the animals. Importantly, no adverse effects on animal performance were observed. Further research could focus on how to improve water delivery systems and how grazing behaviour, season, diet and timing of consumption of the antimethanogenic compound may influence overall effectiveness.

<sup>E</sup>Corresponding author: Gonzalo.martinezfernandez@csiro.au

# Genomic prediction to select for lower methane production in purebred, crossbreed and composite cattle in Northern Australia

Cameron Whistler<sup>A</sup>, Christie Warburton, Kieren McCosker, Ben J Hayes  
QAAFI, University of Queensland, St Lucia 4072

## Introduction

The production of beef cattle in sub-tropical and tropical environments contributes a considerable proportion of anthropogenic methane emissions. Current estimates of methane emissions for beef cattle, and efforts to reduce emissions, largely focus on intensive systems such as dairy or finishing systems. Genomic selection, whereby animals are selected on DNA marker profiles associated with reduced methane emissions, is a cost-effective way to reduce methane emissions. The first step to implementing genomic selection for reduced methane emissions for tropical and subtropical beef cattle is generating a reference population of mixed-breed grazing beef cattle from these regions recorded for methane and genotyped for genome wide markers. In this paper we describe progress towards genomic selection for tropical and sub-tropical beef cattle.

## Methods

Methane production (MP) was recorded using GreenFeed emission monitoring systems (GEM) in several trial sites across Queensland. The number of cattle per trial ranged between 75 and 300 depending on paddock size. In trials between July 2023 and July 2025 an overall recording percentage of 87% was achieved. Alongside recording methane production, trial weight and tail hair samples for genotyping with 90,000 SNP arrays (DNA markers) were collected during trial induction. Genomic best linear unbiased prediction (GBLUP) was used to combine genotypic and phenotypic data to produce genomic estimated breeding values (GEBV) for MP. Additionally, two cohorts of cattle had repeated observations recorded across time, allowing us to investigate how stable methane phenotypes were across time. One group of cows were recorded pre and postpartum to identify how methane production fluctuated due to pregnancy. A group of young heifers were additionally recorded at the same location ~207 days apart to observe if methane production varied due to maturity.

## Results

In total, 921 cattle were recorded for methane emissions and genotyped across 5 sites across Queensland. Using the SNP and phenotype data, a heritability of 0.20 (0.04) was estimated for both total methane emission level and methane intensity (CH<sub>4</sub>g day/kg LWT). Prediction accuracy of MP from this reference population was tested using five-fold cross validation. This involved randomly selecting 20% of the 921 cattle and setting their MP to unknown and using the remaining 80% to predict MP for those cattle, then correlating the predictions with actual methane emissions. A moderate accuracy of  $0.37 \pm 0.04$  with limited bias (regression of phenotype on GEBV of 1.01) was achieved. Correlation between repeated records for pre and postpartum cattle was 0.61 (0.16). The correlation for growing heifers on average of 207 days apart was slightly lower at 0.57 (0.18).

## Discussion and conclusion

Methane production is a difficult trait to observe especially in grazing cattle where multiple factors cause daily variation. Predictions based on genomic information would allow selection for lower methane production without the considerable time and cost of recording methane production directly. The moderate accuracy of genomic prediction achieved here using a modest reference population of mixed-breed cattle shows that selection based on genomic data can predict methane production to some degree. Moderate correlations between pre and postpartum cows suggest that recording methane production utilising GEM once in an animal's lifetime can reasonably capture long term methane emission variation. This is further supported by the correlation between repeated records in growing heifers which shows methane production is moderately repeatable across time.

<sup>A</sup> Corresponding author: c.whistler@uq.edu.au

# Evidence for enhanced soil carbon and nitrogen stocks under time-controlled grazing in the Australian subtropics

Elaine Mitchell<sup>A,C</sup>, David Rowlings<sup>A</sup>, Mark Bonner<sup>A</sup>, Sandie McEwan<sup>A</sup>, Sarah McDonald<sup>B</sup>

<sup>A</sup> Sustainable Agroecosystems, Queensland University of Technology, 2 George Street, Brisbane, QLD: <sup>B</sup> NSW Department of Primary Industries, Orange, NSW.

## Introduction

Soil organic carbon (SOC) underpins soil health and climate resilience. Australian evidence for grazing-based SOC gains has been mixed, often showing little to no effect when management is broadly grouped as “rotational” versus “continuous”. This study tests a clearly defined system—time-controlled grazing (TCG)—against conventional (CONV) practices on ten commercial properties in the subtropical Brigalow Belt, asking whether TCG is associated with higher SOC and nitrogen (N) stocks and more stable SOC forms.

## Methods

A paired-site design compared five TCG–CONV farm pairs (10 properties) matched for soil type, land-use history and climate within the Brigalow Belt. TCG was characterised by higher stocking density, short grazing bouts and long rest periods, with adaptive rotation among many small paddocks; CONV reflected typical regional practice. In 2022, soils were cored (24 points per land unit) to 1 m and analysed for SOC, total N and size-fractionated SOM [particulate organic matter (POM); mineral-associated organic matter (MAOM)]. Mixed-effects models tested treatment effects. Remotely sensed fractional cover (1987–2023) informed ground-cover dynamics analysis, including performance during dry spells.

## Results

TCG had significantly higher SOC than CONV by 15.2 t C ha<sup>-1</sup> (0–100 cm;  $p < 0.001$ ), concentrated in the 0–30 cm layer. Total N was ~1.5 t N ha<sup>-1</sup> greater under TCG ( $p < 0.001$ ). SOC gains were reflected in stabilised pools: MAOM-C (+30%) and MAOM-N (+24%) were higher in TCG, while POM fractions did not differ. Microbial biomass (total, bacterial, gram-positive, actinomycete) was 40–60% higher under TCG; fungal, AMF and F:B ratios showed no consistent differences. Across all years, ground cover showed no overall TCG advantage; however, during dry spells TCG lost less cover and spent ~41% fewer months below the 85% critical threshold post-adoption.

## Discussion and conclusion

Commercial-scale TCG was associated with higher SOC and N stocks and greater MAOM, indicating not just more carbon, but more carbon in longer-lived forms. Elevated saprotrophic microbial biomass is consistent with pathways where sustained inputs promote MAOM formation. These results align with international evidence yet diverge from prior Australian findings, likely because TCG was precisely specified, sites were closely matched, soils were sampled to 1 m, and multiple indicators (e.g. ground cover, species composition, microbial profiles) triangulated effects. The findings indicate TCG is a credible management pathway for improving soil function and climate resilience in subtropical grazing systems.

<sup>C</sup> Corresponding author: e5.mitchell@qut.edu.au

# Biodiversity and carbon storage in a *Corymbia* hybrid silvopastoral system in Northern Australia

Tien Chinh Nguyen<sup>A,D</sup>, David Lee<sup>A</sup>, Helen Nahrung<sup>A</sup>, Teresa Eyre<sup>B</sup>, Nahuel Pachas<sup>A,C</sup>

<sup>A</sup> Forest Research Institute, University of the Sunshine Coast, QLD, Australia, <sup>B</sup> Department of Environment, Tourism, Science and Innovation, QLD, Australia, <sup>C</sup> Department of Primary Industries, Nambour, QLD, Australia, <sup>D</sup> School of Agriculture and Forestry, Tay Bac University, Vietnam

## Introduction

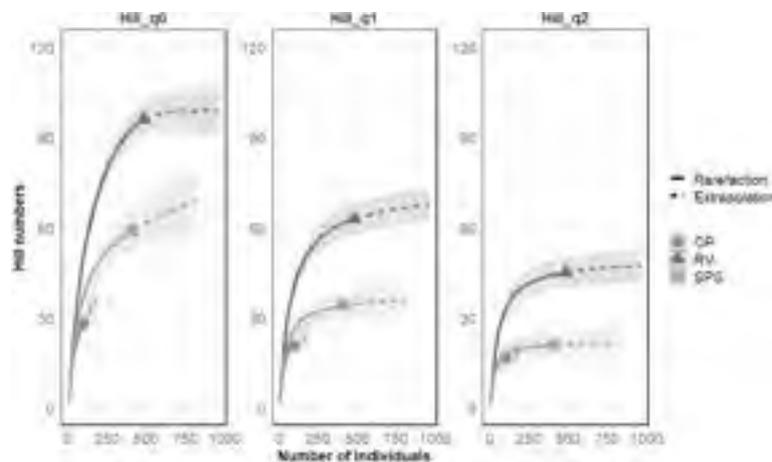
Silvopastoral systems (SPS) are an innovative land use strategy that deliberately integrates trees, pasture and livestock for production, while enhancing biodiversity and carbon storage (Jose and Dollinger, 2019). However, how effectively SPS enhance biodiversity and carbon storage remains unclear in Australia. Our research aims to provide a better understanding of the effects of SPS on biodiversity and carbon storage in Northern Australia.

## Methods

Our research was conducted at Stanwell, Queensland, where a *Corymbia* hybrid plantation planted in 2008 was converted to a SPS ( $141 \pm 15.5$  trees  $\text{ha}^{-1}$ ) in 2021. Birds were observed in three treatments: SPS, open pasture (OP), and remnant vegetation (RV) in 2024 and 2025 (5 days each year), while aboveground carbon was estimated for 4 treatments: OP, SPS, RV, and unthinned plantation (UP).

## Results

The SPS had significantly higher bird biodiversity than OP, but lower than RV (Fig. 1). The RV had the highest total aboveground carbon ( $64.5\text{--}64.6$  Mg C  $\text{ha}^{-1}$ ), followed by UP ( $55.9\text{--}56.3$  Mg C  $\text{ha}^{-1}$ ) and SPS ( $25.6\text{--}25.8$  Mg C  $\text{ha}^{-1}$ ), while OP was the lowest ( $0.86\text{--}2.13$  Mg C  $\text{ha}^{-1}$ ).



**Fig. 1.** Bird biodiversity metrics across treatments. Hill\_q0 is species richness; Hill\_q1 is the exponential of Shannon diversity; Hill\_q2 is the inverse Simpson diversity. Points mark observed sample sizes and shaded areas represent 95% confidence intervals.

## Discussion and conclusion

Silvopastoral systems can enhance bird communities compared to OP but cannot reach the value of RV. While SPS can increase carbon storage relative to OP, it cannot reach the capacity of UP and RV, although SPS can store higher biomass carbon per tree than UP. Establishing and managing SPS seems to be a promising solution to enhance biodiversity and carbon sequestration.

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<sup>A</sup> Corresponding author: Tien.Nguyen@research.usc.edu.au

# Sixty-year experiments, hidden in the Mulga, informing today's issues

Steven Bray<sup>A,H</sup>, Keryn Paul<sup>B,C</sup>, Jacqui England<sup>D</sup>, Ian Beale<sup>E</sup>, Tony Pressland<sup>F</sup>, Bill Burrows<sup>G</sup>

<sup>A</sup> Department of Primary Industries, Brisbane, Qld 4102; <sup>B</sup> CSIRO, Canberra, ACT 2601; <sup>C</sup> KIPES Pty Ltd, Reid, ACT 2612; <sup>D</sup> CSIRO, Clayton South Vic 3169; <sup>E</sup> Mungallala, Qld 4467; <sup>F</sup> Brisbane, Qld 4069; <sup>G</sup> Emu Park, Qld 4710

## Introduction

In the late 1960s, three Mulga woodland thinning experiments were conceived by Joe Ebersohn (DPI) and established in south-west Queensland to understand the impact of thinning to different tree densities on pastoral production. Two of these trial sites have survived largely intact for the last 60 years, due largely to their remote location and landholder goodwill. Original individual tree and plot data were recovered from Queensland Government archives, which supplements data summarised in academic theses and scientific papers from the 1970s. The third site, Charleville Reserve, had experienced some disturbance (tree cutting and clearing – presumably for livestock fodder and vehicle access) and the original tree and plot data have not been located.

Now 60 years after the trials were established, the research priorities have changed, with a modern focus on mulga woodland carbon stocks and sequestration, biodiversity, woody vegetation recovery or regeneration following disturbance and, still an important priority for grazing industries, livestock production. This paper highlights and summarises some of the historic data recovered, the modern woody vegetation assessment and the expected utilisation of the data to inform today's issues.

## Methods

In 1966, two mulga woodland thinning trial sites (Boatman and Monamby) were established with 3 treatments; 40, 160 and 640 trees per ha, and 7 replications (21 plots). 336 individual mulga trees were tagged. In 1970, a third site was established with 6 treatments; 40, 160 and 640 trees per ha, completely cleared with and without fire, and uncleared, with 3 replications (18 plots). Details of the experimental design and historic measurements undertaken were documented in 3 theses and 4 scientific papers in the 1970s (e.g. Beale 1973).

In 2022–2023, each plot was searched and all tagged trees found were re-measured and assigned a health rating. Tag retention, tree growth and tree health data were analysed. Further, in a set area ranging from 1600–6400 m<sup>2</sup> per plot, all trees and shrubs were measured to assess current tree size classes, woodland basal area, species diversity and carbon stocks (data not presented).

## Results

At Boatman, 50% of the tagged trees were located in 2022, of which 34% were dead, either standing or fallen. Mean circumference of live trees (at 30 cm height) had increased from 27 cm in 1966 to 76 cm within the higher tree density treatment, and to 120 cm within the lowest tree density in 2022. At Monamby, 78% of the tagged trees were located, of which 56% were still alive. Mean circumference of live trees increased from 20 cm in 1966 to 58 cm within the higher tree density treatment and to 73 cm within the lowest tree density in 2023. Many missing tagged trees may still be present but with the tag missing, particularly at Boatman where mean tree sizes were larger.

## Discussion and conclusion

Data from these long-term sites are valuable to inform modern issues and associated modelling and remote sensing tools. Key factors that the data will help inform include; woodland vegetation recovery rates following disturbance such as thinning, carbon stock balance and recovery, tree growth and survival rates, and the impact of tree thinning on pasture productivity over decades following a thinning event and subsequent recovery of woodland basal area.

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<sup>H</sup> Corresponding author: [steven.bray@dpi.qld.gov.au](mailto:steven.bray@dpi.qld.gov.au)

# Why are woody plants increasing? The value of long term studies – lessons from a 30+ year burning experiment and 50+ year grazing exclusions

Robyn Cowley<sup>A, C</sup>, Jaidyn Eastaugh<sup>A</sup>, Kate Holzapfel<sup>A</sup> and Gary Bastin<sup>B</sup>

<sup>A</sup> Department of Agriculture and Fisheries, Katherine, Northern Territory; <sup>B</sup> PO Box 2886 Alice Springs

## Introduction

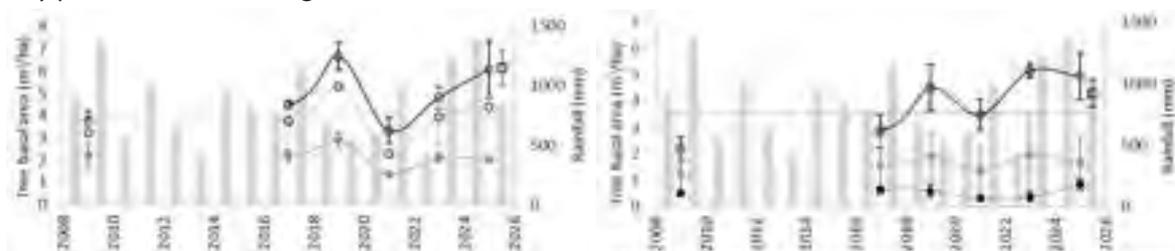
Altered fire regimes, grazing by domestic livestock, rainfall variability and rising carbon dioxide levels are all potential factors influencing observed woody cover increases in Northern Australia. A long-term fire experiment and recently remeasured long-term grazing exclusions at Victoria River Research Station (Kidman Springs) are providing insights into the factors driving vegetation change. We examine the trends in woody cover with different fire treatments, with and without grazing, on a calcarosol Eucalypt woodland and an alluvial black soil grassland to better understand factors driving vegetation change in the region and the implications for recommended management change.

## Methods

A long-term fire experiment has been monitoring tree basal area (TBA) since 2009 (Cowley et al., 2014), while adjacent grazing exclusions have been measuring woody density since 1973 (Bastin et al., 2003). In June 2025 the fire experiment and long term exclusions were monitored using the same methodology for the first time to facilitate comparison across the studies.

## Results

Rainfall was higher in the most recent 35 years averaging 818mm compared to 689mm during the first 20 years since 1973. TBA fluctuated through time on the fire plots due to variable rainfall both with and without fire (Fig. 1). TBA in the ungrazed 50-year exclusions (unburnt except in 2001) was the same as the grazed unburnt sites in the 30-year fire experiment. Inside and outside the long term exclusions, over the first 30 years to 2002, woody plant density increased from close to zero to around 300 plants/ha on the black soil, and 200-800 plants/ha on the red soil. In the 23 years since, woody plant density has more than doubled on the black soil 'grassland' and more than quadrupled on the red soil woodland, with greater increases in exclusions on both soil types (data not shown). Density of woody plants is now 50% higher inside than outside exclusions.



**Fig. 3. Tree basal area on Eucalypt woodland (left) and grassland (right) at Kidman Springs. Mean  $\pm$  SE: Unburnt ungrazed enclosure  $\circ$  Unburnt grazed  $\square$  Burnt Late 4 yearly & grazed  $\triangle$  Burnt Early 4 yearly & grazed  $\blacksquare$  Burnt Late 2 yearly & grazed — Median July to June rainfall 1970-2025**

## Discussion and conclusion

Less fire and more rainfall have probably contributed to increased woody cover and density at Kidman Springs, although higher carbon dioxide levels may also be contributing (Maschler et al., 2022). The greater increases in density of woody plants inside long term exclusions suggests grazing may also be having some moderating effect on woody plant increases in these grazed landscapes.

## References

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<sup>C</sup> Corresponding author: robyn.cowley@nt.gov.au

# Sowing seeds of legume success in Central Queensland

Stuart Buck<sup>AC</sup>, Kylie Hopkins<sup>A</sup>, Polani Shadur<sup>A</sup> and Dana Walkington<sup>B</sup>

<sup>A</sup> Department of Primary Industries, Rockhampton 4702; <sup>B</sup> Department of Primary Industries, Emerald 4720

## Introduction

Establishing perennial legumes into tropical grass pastures increases the productivity and profitability of beef businesses in Northern Australia. However, to achieve these benefits an initial establishment of at least 4 plants/m<sup>2</sup> is required. Under central Queensland conditions, reliable legume establishment is achieved through fallowing to store soil-moisture prior to sowing, obtaining a fine-but-firm seed-bed that is weed-free, planting an adequate rate of high germination seed and lightly covering or rolling to achieve seed-soil contact at the wettest time of year. This paper summarises the agronomic practices used to achieve successful legume establishment at 9 field trial sites across central Queensland in 2025.

## Methods

Trial site locations were selected to cover the variety of soil types (sandy-loam to heavy clay), and average annual rainfall (500–900 mm) and mean minimum winter temperature (6–13 °C) gradients across central Queensland. All sites started as perennial grass-pastures and were fallowed between 5 and 18 months to accumulate soil-water prior to sowing and break down organic matter. Most sites were cultivated (with implements such as offset disc ploughs) and some were also sprayed with herbicide. After the desired seedbed was prepared and approximately 250–700 mm of accumulative rainfall was received over the fallow period, planting commenced in February 2025. All sites were initially rolled with a Cambridge ring roller to reduce clods, or to increase seedbed firmness. Seed was broadcast on the surface then rolled again to improve seed-soil contact. Bare stylo (*Stylosanthes spp*) legume seed with an average germination of 37% (range 12–60%) was sown at 2.1 kg/ha. Herbicide was applied after sowing at all sites to control grass and broadleaf weeds during the initial establishment phase. Between 3-5 months after sowing, plant density (plants/m<sup>2</sup>) was assessed. Challenges encountered during the establishment process were recorded.

## Results

All sites established successfully with an average legume plant population of 11.3 plants/m<sup>2</sup>. Low populations occurred where less germinable seed was applied. Challenges encountered included reducing the high starting pasture biomass and background pasture and weed-seed populations. This was managed through multiple cultivation and herbicide operations in the fallow period and some in-crop herbicide applications after planting. The main seed germination event occurred within about 5 weeks from planting, with some sites receiving high rainfall totals (around 280 mm) whereas other sites had lower rainfall totals (around 90 mm) over the same period.

## Discussion and conclusion

Successful legume establishment at 9 trial sites on a range of soil types and rainfall conditions demonstrates the value of good agronomic practices to achieve a plant density of over 4 plants/m<sup>2</sup>. The process of 1) fallowing to store moisture and control weeds, 2) cultivating to prepare a seed bed, 3) rolling for good seed-soil contact, 4) sowing high germination seed and 5) spraying to control in-crop weeds reduces the risk of a failed establishment in summer-dominated rainfall environments (Peck et al, 2015). Despite this process being conducted on small areas for research trials, these principles are equally applicable, and successful, in commercial sized situations.

## References

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<sup>C</sup> Corresponding author: stuart.buck@dpi.qld.gov.au

# Old evaluation trials delivering a legacy of new persistent legume varieties

Gavin Peck<sup>A</sup>, Ian Dunbar, Ajay Augustin

Department of Primary Industries, Toowoomba 4350

## Introduction

Finding legume varieties that are persistent and productive in the long-term for the Brigalow Belt climatic zone has been challenging. Graziers advise that most of the legume cultivars that were previously released for use in the Brigalow Belt were not persistent with competitive sown Buffel grass (*Cenchrus ciliaris*) pastures typical in the region. The highest priority trait for new legume varieties identified by graziers is long-term persistence described as >20 to 50 years; however, research funding cycles are typically 3 to 5 years, which means that long-term persistence cannot be directly measured before legume accessions are selected for release as new cultivars. This paper describes using a network of old pasture evaluation trials sites to identify legume species, cultivars and experimental accessions that have persisted and are productive in the long-term.

## Methods

Forty-eight old pasture evaluation trials located across the Brigalow Belt bioregion were inspected. Re-visiting and describing the trial sites relied on multiple retired pasture scientists that had established the trials. The average age of the trial sites at the time of inspection was 18 years post sowing.

The old trial sites were initially inspected to describe long-term persistence of commercially available legume varieties; however, these sites also enabled the identification of non-released accessions for further evaluation and potential release as new cultivars. Legumes re-collected from these trials have been evaluated in new research programs, with some lines identified for release as new persistent and productive varieties.

## Results

Some commercially available legume varieties persisted across broad geographical areas of the Brigalow Belt; however other legumes commonly recommended to graziers were not widely persistent. Five new stylos have been identified for release as new varieties with 40-70% higher yield and better persistence on light textured soils in frosty locations. Two additional stylo and two *Desmanthus* accessions have been identified for further evaluation. These accessions recorded two to four times higher yields than commercially available varieties in a limited number of trial locations.

## Discussion and conclusion

More widespread and successful adoption of legumes is critical to sustainably improving the productivity and returns for grazing industries in the Brigalow Belt climate zone that carries 30% of Northern Australia's beef herd. The network of old pasture evaluation trials across southern and central Queensland provided valuable insights about the long-term performance of commercially available legume cultivars and identified better-performing legume accessions for potential release as new varieties.

Five new stylo varieties that were identified and re-collected from old trial sites have the potential to increase the geographic range suitable for sowing legumes in southern Queensland (i.e. previously there were no suitable legume varieties), as well as improving productivity for large areas where existing varieties are suited. Two additional shrubby stylo accessions were identified and are being evaluated as potential replacements for cv. Seca, which is the most widely used legume in Northern Australia. New research has commenced that has identified improved *Desmanthus* accessions, with further work potentially identifying other accessions with useful traits for industry.

<sup>A</sup> Corresponding author: Gavin.Peck@dpi.qld.gov.au

# Augmenting native pastures with legumes as a pathway to resilience and increased productivity in the Victoria River District of the NT

Mary Williams<sup>A,C</sup>, Melissa Wooderson<sup>A</sup>, Caroline Pettit<sup>B</sup>

<sup>A</sup> Department of Agriculture and Fisheries, Katherine, NT 0850, <sup>B</sup> Department of Agriculture and Fisheries, Darwin, NT 0828

## Introduction

The Victoria River District (VRD) of the Northern Territory experiences high variability in rainfall and pasture growth. Pasture growth is generally confined to the wet season, with a pronounced drop in diet quality during the dry season leading to a protein gap and therefore, slower live weight gains.

Research across Northern Australia has demonstrated that augmenting native pastures with legumes can improve diet quality and increase cattle liveweight gain (Coates et al., 2009). Tropically adapted legumes such as *Stylosanthes* spp. are already naturalised in parts of the VRD, but the extent that introduced legumes enhance cattle performance in the region is not well documented. To provide benchmark data, a grazing study at Victoria River Research Station (VRRS) measured liveweight gain of weaner heifers.

## Methods

A paddock scale comparison was conducted at VRRS using 2 paddocks. One paddock (Legume) contained naturalised *Stylosanthes* spp. (31% of pasture yield) while the other (Control) contained little to no introduced legumes (7% of pasture yield). Cohorts of weaner heifers were allocated to each paddock at weaning and grazed there from June to May over 2 consecutive years. The stocking rate was matched to the assessed carrying capacity in both paddocks. Average daily gain (ADG) was calculated for each cohort.

## Results

Results are presented in Table 1.

**Table 1. Average daily gain (ADG) of heifers in the Legume and Control paddocks at VRRS**

Year	Rainfall (mm)	Treatment	Number of animals (stocking rate hd/km <sup>2</sup> )	ADG (kg/day) (95% Confidence range)
Jun '23- May '24	1385	Control	45 (15)	0.324 (0.303, 0.346)
		Legume	31 (16)	0.381 (0.353, 0.408)
Jun '24 – May '25	702	Control	96 (14)	0.403 (0.387, 0.418)
		Legume	25 (13)	0.433 (0.405, 0.462)

## Discussion and conclusion

Heifers grazing in the Legume paddock consistently recorded greater liveweight gains than those grazing predominantly native pastures in the Control paddock. This is consistent with previous studies (Coates et al 2009) and suggests that augmenting native pastures with legumes has the potential to improve growth rates in the VRD. Average daily gains were higher in 2024-25 (a 50%ile rainfall year) than in 2023-24 (a 99%ile rainfall year) highlighting the influence of seasonal variability on production outcomes. Augmenting native pastures with legumes could improve late dry season growth, giving greater market flexibility, reducing grazing pressure and emissions through faster turn off times. This study provides indicative benchmark data for average and above average rainfall years.

## References

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<sup>C</sup> Corresponding author: mary.williams1@nt.gov.au

# Demonstrating the challenges of augmenting native pastures with legume cultivars on cracking clay soils in the Victoria River District (VRD), NT

Michael Finey<sup>A</sup>, Caroline Pettit, Arthur Cameron

Department of Agriculture and Fisheries (DAF), Berrimah Farm, Darwin, NT, 0801

## Introduction

Augmenting native pastures with introduced legumes to improve cattle production in Northern Australia has a long history (Stocker and Sturtz 1966). However, there is still considerable interest in finding the best establishment methods for sub-tropical regions of the Northern Territory (NT). This paper presents findings from a study comparing establishment of four legume species on cracking clay soils under different combinations of burning (to reduce competition prior to sowing) and sowing rates.

## Methods

A field study was conducted at Victoria River Research Station, NT. A seed mixture containing four legume cultivars was hand sown in January 2025 across 12 plots (10 m x 17 m) on cracking clay soils. Species included *Clitoria ternatea* cv. Milgarra, *Desmanthus virgatus* cv. Progardes, *Stylosanthes hamata* cv. Verano and *Stylosanthes scabra* cv. Seca. Treatments followed a strip plot design including burnt and unburnt with three cultivar seed rates (0.2, 0.5, and 1.0 kg/ha) and two replicates. The numbers of legumes that established were recorded in May 2025 and analysed using ANOVA, with treatment means compared using Tukey's LSD ( $P < 0.05$ ).

## Results

Increasing sowing rate significantly improved establishment of cv. Milgarra ( $P = 0.007$ ). In contrast, Progardes, Verano and Seca showed no significant response to either burning, seed rate, or their interaction (Table 1).

**Table 1. Cultivar establishment (mean plants per plot at three sowing rates).**

Cultivar	Treatment	0.2 kg/ha	0.5 kg/ha	1 kg/ha
<i>Progardes</i>	burn	0.0	0.0	2.0
	control	0.0	2.0	1.0
<i>Verano</i>	burn	0.5	3.0	24.0
	control	1.5	5.5	5.0
<i>Seca</i>	burn	0.0	0.0	2.5
	control	0.5	1.5	0.0
<i>Milgarra</i>	burn	2.0	8.5	34.0
	control	3.0	15.5	21.5

## Discussion and conclusion

High variability within plots, especially where plant numbers were low, may have limited the detection of treatment effects. Burning had no statistically significant effect on establishment in this one-year trial, however, larger commercial paddock trials in the region showed a trend towards higher establishment in burnt plots. These differing outcomes highlight the variability of legume establishment on cracking clays and the associated risk of inconsistent results. Augmenting native pastures in this region remains challenging, with low and variable establishment likely to delay production benefits. As noted by Gramshaw et al., (1993), management interventions can be ambiguous with establishment success being offset by overriding biotic and abiotic factors.

## References

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Stocker G, Sturtz J (1966) *Australian Journal of Experimental Agriculture* 6(22), 277-279.

<sup>A</sup> Corresponding author: michael.finey@nt.gov.au

# Long-term dynamics of species composition in the Northern Territory rangelands: a 50-year perspective

Jaidyn Eastaughffe <sup>A,D</sup>, Robyn Cowley <sup>B</sup>, Kate Holzapfel <sup>A</sup>, Gary Bastin <sup>C</sup>

<sup>A</sup> Northern Territory Department of Agriculture and Fisheries, Katherine 0850; <sup>B</sup> Northern Territory Department of Agriculture and Fisheries, Alice Springs 0870; <sup>C</sup> Alice Springs 0870

## Introduction

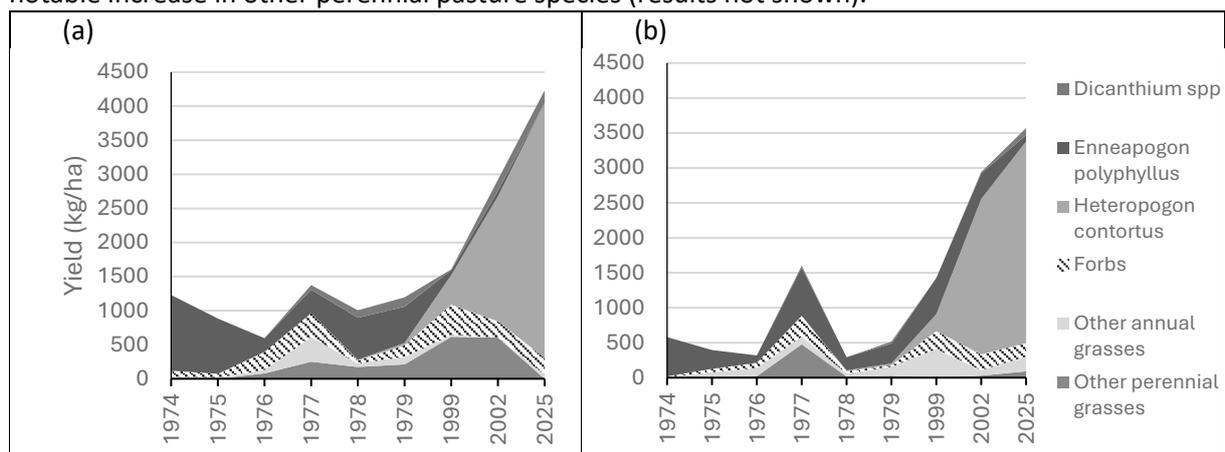
To better understand how vegetation responds to climate variability and disturbances such as fire and grazing, three exclosures were established at Victoria River Research Station in 1973. Observations made inside and outside these exclosures over the last 50 years provide valuable insights into regional vegetation changes and the main factors driving them.

## Methods

In June 2025, seventeen of the original thirty-six plots were remeasured for the first time since 2002 using the same methodology as per (Cowley et al., 2014) and (Bastin et al., 2003), with data usually collected in June. Recommended stocking rates have been implemented in grazed areas.

## Results

The alluvial black soil grassland sites had relatively stable species composition dominated by *Chrysopogon fallax* and other perennial grasses through time both with and without grazing, with a notable increase in other perennial pasture species (results not shown).



**Figure 1: Species composition for the calcarosol Eucalypt woodland (a) exclosed site; (b) grazed site. Note: x-axis is not to scale.**

## Discussion and conclusion

The general stability of the alluvial sites suggests a high level of resilience to disturbances such as fire, recommended levels of grazing and changing climatic conditions. On the red soil, the shift from annual short grass to perennial tall grass has continued both inside and outside exclosures, suggesting that climate, not grazing is driving these changes. Between 1977 and 2002 *Dicanthium fecundum* and other perennial grasses yield were consistently higher within the exclosed sites (av. 29% vs. 10%), but in 2025 the main difference was the presence of more short-lived grasses with grazing (1% ungrazed vs. 8%). The first two decades showed minimal change, highlighting the importance of long-term research to capture the complex interactions between climate, grazing and vegetation.

## References

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Cowley R. et al. (2014) *The Rangeland Journal* 36(4), 323-345.

<sup>D</sup> Corresponding author: Jaidyn.Eastaughffe@nt.gov.au

# Improved monitoring of pastoral landscape productivity and trends in the rangelands

*Juan Guerschman<sup>A</sup>, Phil Tickle, Peter Scarth*

Cibo Labs Pty Ltd, Point Arkwright, Queensland, 4573, Australia

## Introduction

The extensive pastoral regions of Australia necessitate scalable, consistent, and objective tools for monitoring land condition to support sustainable grazing practices and optimize pasture productivity. Traditional methods are often resource-intensive and lack the temporal frequency required for proactive management. This paper summarises an 18-months (October 2025 – March 2027) research, development, and commercialisation project, a collaboration between Meat & Livestock Australia (MLA) and Cibo Labs. The project's overarching goal is to develop a commercial-ready digital product that leverages advanced spatial analytics to provide high-frequency, reliable land health metrics, empowering producers to enhance productivity, profitability, and resource stewardship.

## Methods

The project methodology integrates high-frequency remote sensing data with advanced spatial and machine learning analytics, translating complex scientific models into actionable, property-level insights. The technical approach is built upon three core components:

- **Landscape Response Units (LRUs):** The development and application of LRUs, which are spatial strata that normalize remote sensing data based on underlying landscape variation (e.g., soil type, geology, climate). LRUs are essential for establishing a consistent baseline and enabling accurate comparative analysis of land performance across different paddocks and regions.
- **Land Condition Models:** Development and validation of key remote sensing indicators, including high-resolution Fractional Cover (estimating green, dry, and bare ground) and Pasture Biomass estimation models. These models are derived from multi-sensor satellite imagery (e.g., Sentinel-2, Landsat).
- **Validation and Calibration:** A dedicated program of on-ground data collection is implemented. This involves systematic scientific field measurements and the application of the 'ABCD' land condition classification framework to calibrate and independently validate the accuracy and utility of the digital models, ensuring real-world relevance for producers.

The primary outcome is the fully operational Land Condition Monitoring Product – a dashboard and reporting tool that provides objective, historical, and current data on land health indicators. Supporting deliverables include scientifically validated models, peer-reviewed publications, and on-farm case studies demonstrating the economic benefits of data-driven land management, such as improved carrying capacity analysis and support for Soil Organic Carbon (SOC) models.

## Discussion

The MLA-Cibo Labs Land Condition project successfully transitions cutting-edge remote sensing science into a highly scalable and actionable tool for the pastoral industry. By providing objective, high-frequency data, the product directly addresses the industry's need for consistent monitoring across vast landscapes. This platform moves beyond simple indices to offer biophysically meaningful indicators normalised by LRUs, significantly improving the quality of land health reporting. The commercial-ready solution supports critical producer decision-making in grazing management, drought preparedness, and environmental reporting, marking a significant advancement in integrating technology for enhanced sustainability and resilience in Australia's rangelands.

<sup>A</sup> Corresponding author: JGuerschman@cibolabs.com.au

# Legume production paddocks improve dry season diet quality and animal performance on fertile soils in north Queensland

Kendrick Cox <sup>A</sup>, Bernie English, Craig Lemin, Steven Dayes, and Luke Bambling

Queensland Department of Primary Industries (DPI), Mareeba, Qld.

## Introduction

Beef cattle production in the seasonally dry zone of north Queensland is based on uncleared native grasslands with significant nutrition deficits during the dry season (Rolfe *et al.*, 2016). Targeting improved dry season nutrition of weaners and steers, DPI researchers and Meat and Livestock Australia, are scaling-up research to commercial size paddocks after demonstrating the potential for shrub legume (e.g. stylo) and leucaena production paddocks in north Queensland (Cox *et al.*, 2025).

## Methods

Commercial scale demonstrations were established on two properties to compare average daily gain (ADG) and diet quality in two production paddock systems: Site 1 - 65 ha Redlands hybrid leucaena in a run-down Buffel paddock (2 cohorts of 40 450-500 kg steers) compared to 280 ha native grass-Buffel (2 cohorts of 150 and 120 225-425 kg steers), both on alluvial soils. Site 2 - 6 ha Caatinga stylo and butterfly pea in black speargrass woodland dominated by Indian couch and grader grass (6 heifers averaging 227 kg/hd) compared to an adjacent large undeveloped paddock (cow & calves), on a red basalt soil. Both sites have soils with high available P, low S and 700-800 mm annual rainfall. Both were intermittently grazed, but the results presented below are for extended periods of continuous grazing. ADG was measured using Optiweigh™ at site 1 and individual weighing at site 2. Regular FNIRS testing was used to assess diet quality. The same dry season supplements were used at each site.

## Results

Dry season diet quality (crude protein (CP) and metabolisable energy (ME) was significantly higher in the legume paddocks compared to native pastures (Table 1). Leucaena leaf was produced most of the year at site 1 and comprised a high component of the diet (50 to 100%). Diet quality in the stylo paddock at site 2 declined as the availability of legume declined but increased once pasture growth resumed after December rainfall. Higher dietary quality translated into higher ADG in the legume paddocks at both sites.

**Table 1.** Range of diet quality and liveweight gain of cattle grazing different paddocks (2024-25).

Site/Grazing system	Grazing period	Grazing days	ADG (kg/day)	Number recorded	FNIRS frequency	Dietary CP (%)	Dietary ME (MJ/kg DM)
1/Leucaena	3/4-25/6	84	1.02	24	6-7 weeks	12.7-13.3	8.1-8.6
1/Native grass	10/4 – 25/6	77	0.45	9	6-7 weeks	5.9-9.4	7.2-7.9
1/Leucaena	25/7-7/11	105	0.15	19	6-8 weeks	6.6-12.7	6.7-8.4
1/Native grass	25/7-7/11	105	-0.43	20	6-8 weeks	2.2-4.4	5.7-6.4
2/Stylo	1/9-29/1	150	0.29	6	8-10 weeks	3.9-11.3	5.7-7.7
2/Native grass	1/9-29/1	150	-	-	8-10 weeks	3.2-9.5	6.0-8.0

## Discussion and conclusion

These results support earlier research on the development of perennial legume-based production paddocks to improve diet quality and animal performance in the dry season. The use of these systems should enable producers to also reduce dry-season nitrogen supplementation.

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<sup>A</sup> Corresponding author: kendrick.cox@dpi.qld.gov.au

# Species proportion trends on the Richmond Downs post 2019 flood

Greta Dunne<sup>A,C</sup>, Jim Fletcher<sup>B</sup>

Department of Primary Industries, <sup>A</sup>Cloncurry QLD 4824; <sup>B</sup> Mackay QLD 4740

## Introduction

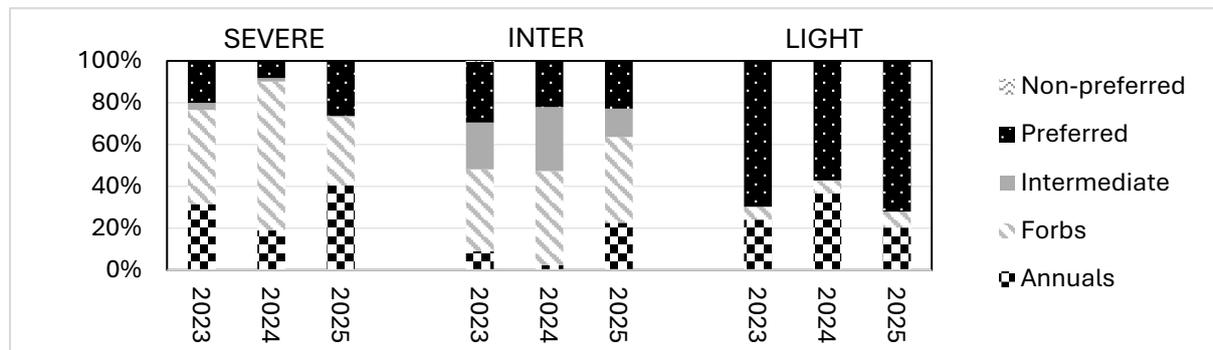
In 2019, north-west Queensland experienced extreme monsoonal rainfall, with over 800 mm falling in less than a week. This led to widespread flooding across hundreds of thousands of hectares of grazing land, lasting up to 15 days. The recovery of Mitchell Grass Downs has varied across the region. To better understand this recovery, monitoring sites were set up on a property south of Richmond, Queensland.

## Methods

Six monitoring sites were chosen based on the severity of flood impact—two each for severe, intermediate, and light impact. At each site, 30 BOTANAL assessments were conducted (Lamacraft, R.R, 1979). For each assessment, the top five pasture species within a quadrat were identified, and their percentage composition was recorded to evaluate species composition.

## Results

On ‘severe’ sites, pasture composition comprised 41% annual grass and 50% Forb species. Preferred species composition declined to as low as 8.15% in 2024 but increased to over 25% in 2025. ‘Intermediate’(INTER) sites were dominated by intermediate species such as *Eriochloa*, *Eragrostis*, *Panicum*, and *Desmodium*. Preferred species, including Mitchell Grasses, fluctuated on ‘intermediate’ sites throughout the trial, contributing an average of 24% to the pasture composition, with some years, such as 2025, recording as low as 3.65%. In contrast, ‘light’ sites consistently maintained a high proportion of preferred species, averaging 66% of the pasture composition (Fig. 1).



**Fig. 4. Proportion of biomass at Rose Downs by pasture type over 3 years on intermediate, severe and lightly effected sites.**

## Discussion and conclusion

The findings highlight the complexity of pasture recovery, with no clear trends or definitive answers across sites. Although monitoring has covered only a small number of seasons, no consistent trend in pasture improvement is evident. While ‘light’ sites, experienced fluctuations in forb and preferred pasture proportions, they consistently maintained higher levels of preferred species compared to other sites. ‘Severe’ sites show subtle changes in pasture composition demonstrating the challenges of Mitchell Grass establishment (preferred pasture). The recovery of Mitchell Grass Downs is a slow process that could take decades, with no clear timeline evident in this study. Where recovery is prolonged, targeted interventions may be warranted to return impacted sites to their previous state.

## References

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<sup>C</sup>Corresponding author: greta.dunne@dpi.qld.gov.au

# Understanding herd performance requires clarity in classifications

*Ian McLean<sup>A</sup>, Harry Evans*

Bush AgriBusiness Pty Ltd, Toowoomba QLD 4350

## Introduction

Industry analyses have identified that there is substantial variation in herd performance across the beef industry and significant room for improvement in herd performance (Henderson et al., 2013, McLean et al., 2023).

Accurate herd numbers are important to understanding improving herd performance; however, there is no standard way to record and classify livestock numbers, resulting in many producers being unaware of performance issues within their herd. Having accurate herd data isn't easy, animals not staying in the paddock they were put in, growing, reproducing and dying in unknown numbers all contribute to the challenge.

However, the challenge is compounded by the lack of consistency around livestock classifications and when and how animals move from one class to another as they age.

## Discussion

To address this issue, we recommend three primary attributes be used to classify animals in extensive beef herds;

- AgeYear: the year corresponding to the brand &/or tag colour used
- Sex: female, castrate or bull
- Reproductive Status: reproducing or non-reproducing

AgeYear is not necessarily the birth year, it is the brand number &/or tag colour that is applied to each age group of calves. This typically (but not universally) corresponds to the financial year of birth in Northern Australia (i.e. those born in FY26 are #26), and calendar year in southern Australia. Whilst there may be differences in how individual businesses apply AgeYear, if it is consistently applied by each business, it can still be used as a reliable attribute. The default tag colour relating to the AgeYear should be used.

Sex will only change if natural increase recorded as bulls are subsequently castrated. Reproductive status should only change once, if females no longer intended for reproduction are retained to finish or grow out before sale, the reproductive status will change to non-reproducing. All young females intended for reproduction should be classified as reproducing until it is decided otherwise. Classifying grown cleanskin bulls as non-reproducing distinguishes them from herd bulls.

These three attributes are unambiguous, do not frequently change, and provide a standardised way of categorising livestock.

## Conclusion

Removing ambiguity in livestock classifications will improve the accuracy of herd record keeping. Accurate record keeping will result in an improved understanding of actual herd performance. This approach is expanded on in the Australian Herd Classification Guidelines (Bush AgriBusiness, 2025).

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<sup>A</sup> Corresponding author: [ian@bushagri.com.au](mailto:ian@bushagri.com.au)

# Unveiling the performance drivers of Northern Australian beef systems: A time series analysis (1990-2022)

*S.P. Dissanayake<sup>A</sup>, N. Hilmiati<sup>B</sup>, D. Mayberry<sup>C</sup>, K. Eyre<sup>A</sup> and L.F.P. Silva<sup>A,D</sup>*

<sup>A</sup> QAAFI, UQ, St Lucia, QLD 4072; <sup>B</sup> NRIA, Jakarta, Indonesia; <sup>C</sup> CSIRO, BioScience Prec, St Lucia, QLD 4067

## Introduction

Key determinants of herd productivity in North Australian beef systems include reproductive rates, mortality rates, and sale weights. Despite its economic importance, the performance of beef enterprises in Northern Australia remains highly variable (McLean et al., 2023). Therefore, enhancing the productivity and sustainability of beef cattle systems in dry tropical regions requires a deeper understanding of the long-term drivers of performance and the dynamics of system adjustment. We hypothesised that reproductive efficiency, farm inputs, and financial structure are significant long-run drivers of system performance, and that tropical beef systems respond dynamically to shocks over time.

## Methods

This study used Panel Vector Error Correction Models (PVECM) and 32 years of regional data (1990–2022) to investigate the socio-economic and environmental determinants of beef cattle production and productivity in Northern Australia. The data were obtained from the Australian Bureau of Statistics, Australian Bureau of Agricultural and Resource Economics and Sciences and the Bureau of Meteorology.

## Results

The PVECM analysis for beef production revealed positive long-run relationships with branding rate, total labour used, farm capital and farm debts, and negative relationships with land size, non-farm income, liquid assets, and rainfall. The productivity model identified positive effects for non-farm income, livestock contract costs, farm liquid assets and rainfall, while business debt was determined to have a negative effect. In the short-run, the production model showed adjustments for total labour used, farm capital, non-farm income, liquid assets and farm debts, indicating these variables help rebalance the system after shocks. In the productivity model, with adjustments evident in branding rate and rainfall, suggesting these variables respond dynamically to deviations in short-run productivity.

## Discussion and conclusion

This study provides one of the first system-level, dynamic assessments of beef cattle performance in Northern Australia using PVECMs. By examining the interactions between reproduction, labour, financial indicators, and environmental variability across 32 years, we offer new evidence that long-term productivity and production outcomes are shaped not by isolated variables but by persistent interactions among key management and contextual drivers. Our findings confirm that reproductive performance (e.g., branding rate) is a significant determinant of long-term beef cattle production and year-to-year variation in beef cattle productivity. Farm capital and farm liquid assets strongly influence year-to-year beef production patterns in Northern Australia. Importantly, the modelling approach identifies not only which factors matter, but how they matter, clarifying the relative timing, persistence, and influence of shocks within the beef cattle production systems.

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<sup>D</sup> Corresponding author: l.pradaesilva@uq.edu.au

# Key drivers of profitability within north Australian beef breeding businesses

Kieren McCosker<sup>A,C</sup>, Ian McLean<sup>B</sup>

<sup>A</sup> QAAFI, The University of Queensland, Gatton, Qld; <sup>B</sup> Bush Agribusiness Pty Ltd, Toowoomba, Qld

## Introduction

Profitability of Northern Australia beef breeding businesses is highly variable and influenced by many factors, including seasonal conditions, markets, location, and management decisions. Understanding the impact different factors have on profit helps producers make confident decisions that improve business performance and build resilience. Historically, these relationships have often been estimated using herd models. Bush AgriBusiness assists beef businesses to systematically capture business and herd performance data, critically analyse it, and provide insights for improvement. This paper presents the results from a machine learning approach to identify the key drivers of herd income from annual business performance data across 42 northern beef breeding enterprises.

## Methods

Long term annual performance data from 42 northern beef breeding enterprises (27 with >10 years and 15 with 6–9 years of consecutive data) were analysed. Key variables included enterprise size (animal equivalents, breeders, total herd), herd dynamics (annual change in female, male, and total herd numbers), purchase and sale parameters (average liveweight, price, and number of animals by sex), reproductive rate, mortality, and herd productivity. Annual business income (gross profit per animal equivalent) was used as the dependent variable. Gross profit is the net income of the enterprise; annual sales of the enterprise, less purchases plus/minus the value of the herd increase/decrease each year. Gross profit per animal equivalent is effectively a measure of income generated for each unit of grass consumed. LASSO regression was employed to identify the variables most strongly associated with enterprise income while controlling for multicollinearity among predictors. The impact of identified income drivers were subsequently re-estimated using ordinary least squares (OLS) and a fixed-effects panel data model to obtain unbiased coefficient estimates and assess within-enterprise effects over time. All statistical analyses and model estimations were conducted in R (version 4.4.1).

## Results

LASSO regression identified nine key parameters for breeding herd income. Using these variables, the fixed-effects panel regression model demonstrated strong explanatory power ( $R^2 = 0.85$ ,  $p < 0.001$ ) across the 42 businesses. Productivity (kg/AE) was the strongest predictor of income ( $p < 0.001$ ). Male sale price ( $p < 0.001$ ), female sale price ( $p < 0.001$ ), and proportion of male sales ( $p < 0.001$ ) were highly significant drivers. Reproductive performance, male sale weight, and the change in male sales proportion also positively influenced income, while female purchases and male purchase weights showed negative associations with herd income. Mortality was strongly correlated with productivity and was included when productivity was excluded from the model.

## Discussion and conclusion

These results demonstrate that productivity (kg/AE) is the paramount driver of income in northern beef breeding businesses, emphasising the importance of efficiently converting feed resources into saleable product. Reproduction was highlighted as a fundamental determinant through its effect directly, and indirectly via male sale volumes. Price realisation for both males and females emerged as critical factors, highlighting the significance of marketing decisions and market timing. The negative association between female purchases and income highlights the financial cost of herd rebuilding, reinforcing the importance of maintaining land condition and feed resources to avoid destocking breeding females during adverse conditions. These findings identify key areas for management focus to improve business profitability and long-term sustainability.

<sup>C</sup> Corresponding author: kieren.mccosker@bigpond.com

# Bioeconomic evaluation of prepartum nutritional supplementation in Northern Australian beef production systems

S.P. Dissanayake<sup>A</sup>, K. Eyre<sup>A</sup> and L.F.P. Silva<sup>A,B</sup>

QAAFI, The University of Queensland, St Lucia, QLD 4072

## Introduction

Nutrition during the final trimester of pregnancy of a beef cow is critical for the productivity and profitability of beef cattle systems in Northern Australia. This study modelled the bioeconomic impacts of improved late-gestation supplementation implemented across ten Northern Australian beef enterprises, using assumptions derived from the Calf-Alive project, evaluating the three-year impact of late gestation supplementation on reproductive performance.

## Methods

The Breedcow+ herd budgeting software was used to model the bioeconomic impacts of late gestation supplementation (~350 g CP per head per 500 kg LW cow) across three properties: Property A (family-owned), Property B (large-scale pastoral company), and Property C (live export). The data for 2023/2024 period were analysed to assess the impacts. The intervention resulted in a 10% increase in reconception rate of heifers, higher weaning weights (+9 kg), greater weight gains in both dry cows and heifers (+11 kg), early conception (+2%) and raised calf survival by 5.1% through reduced cow (-1%) and calf (-4.1%) mortality. A local sensitivity analysis was conducted by varying conception rate, intervention cost, and beef cattle price by  $\pm 10\%$  to assess the robustness of outcomes.

## Results

Modelling of the late gestation supplementation intervention indicated improvements of 6%, 5%, and 4% in overall reproductive performance for properties A, B, and C, respectively. A benefit-cost ratio greater than 1 demonstrated that late-gestation supplementation yields positive economic returns across all three properties (Table 1).

**Table 1. The modelled bioeconomic impact of the intervention in three properties.**

Property	Property A		Property B		Property C	
Region	Northern Downs, QLD		Barkly, NT		Katherine, NT	
Herd size (Adult Equivalent)	4300		43000		2800	
Target market	Selling weaner heifers and 2-year steers		Selling all weaners		Live export feeder steers	
Impact of the intervention	Baseline	Intervention	Baseline	Intervention	Baseline	Intervention
Number of breeders mated	2,444	2,253	27,946	25,903	1,968	1,837
Saleable liveweight (kg/AE)	150	152	130	134	136	140
Gross profit (\$/AE)	\$425.1	\$438.8	\$352.8	\$371.1	\$394.3	\$410.2
Total cost (\$/AE)	\$340.1	\$348.2	\$211.7	\$220.7	\$236.5	\$245.9
EBIT/AE	\$85.0	\$90.6	\$141.1	\$150.4	157.8	164.3
Benefit-Cost ratio	-	1.68	-	2.02	-	1.71
Feasible cost (\$/Pregnant cow)	-	\$74.0	-	\$89.0	-	\$75.2

Sensitivity analysis showed that all three properties were highly sensitive to beef price fluctuations, with Property B moderately sensitive to reconception rate and Properties A and C moderately sensitive to intervention cost.

## Discussion and conclusion

The targeted intervention generated bioeconomic improvements across three properties, despite regional and market differences. The benefit-cost ratios showed that the economic gains clearly outweighed the intervention's costs. Feasible cost estimates per pregnant cow suggested that the investment remains financially attractive regardless of production scale or target market. Beef cattle sale price was the most influential factor under the current cost assumptions; however, reconception rate and intervention cost had smaller, but predictable effects on the economic performance.

<sup>B</sup> Corresponding author: l.pradaesilva@uq.edu.au

# Economic evaluation of establishing pasture legumes in the Brigalow Belt

Matt Thompson <sup>A,E</sup> Harry Milbank<sup>B</sup>, Gavin Peck<sup>C</sup> & Stuart Buck<sup>D</sup>

<sup>A</sup> Department of Primary Industries (DPI), Townsville 4814, <sup>B</sup> DPI Bundaberg 4670; <sup>C</sup> DPI, Toowoomba 4350, <sup>D</sup> DPI Rockhampton, Qld 4702

## Introduction

Pasture legumes are the best long-term management option for increasing productivity and profitability from grass dominated pastures in the Brigalow Belt bioregion through improving pasture yield and livestock performance. However, successful adoption rates of legumes remains low with poor establishment being a common reason for failure in commercial paddocks. This paper summarises findings of a recent economic evaluation (Thompson et.al 2025) of 29 leucaena, desmanthus/stylo (Des/Stylo) and medic establishment options currently available to producers on high, moderate, and low productivity (and non-arable) land types. The findings aim to inform future investment decisions for producers and industry research and extension.

## Methods

This evaluation defines the processes and costs to establish legumes on a 500 ha production paddock and quantifies the additional ongoing expenses and impacts on pasture and cattle production and gross margins over 30 years. Establishment methods included cultivation and planting in one-pass (low cost; Low\$), whole paddock (high cost; Hi\$) and cultivated strips (Strip). Failure rates were factored into the modelling along with fallowing and phosphorus fertiliser application (+P). Investment performance was measured using discounted cashflow analysis by calculating the marginal differences in cash flow between the base scenarios for each productivity zone and the legume scenarios.

## Results

The 2 best performing options for each investment performance measure are shown in Table 1. Establishing leucaena increased profitability most on high and moderate productivity land but did not rank as well in other measures. Establishing Des/Stylo in strips performed well across all metrics on all land types including increased profitability, high rate of return, fast payback and low cash flow deficit.

**Table 1. Top two performing legume establishment options (modelled on 500 ha).**

Land productivity	Largest increase in profitability (\$million)	Highest % return per \$ invested	Fastest payback (years)	Lowest cash flow deficit (\$million)
<b>High</b>	Leucaena 1.5	Des/Stylo Strip 62%	Des/Stylo Strip 8	Medic Low\$ -0.05
	Des/Stylo Strip 1.3	Medic Low\$ 39%	Medic Low\$ 8	Des/Stylo Low\$ -0.1
<b>Moderate</b>	Leucaena +P 1.7	Des/Stylo Strip 513%	Des/Stylo Strip 6	Des/Stylo Strip -0
	Des/Stylo Strip +P 1.5	Des/Stylo Strip +P 337%	Des/Stylo Strip +P 6	Des/Stylo Strip +P -0
<b>Low: Arable</b>	Des/Stylo Strip +P 0.9	Des/Stylo Strip +P 50%	Des/Stylo Strip +P 8	Des/Stylo Strip -0.06
	Des/Stylo Hi\$ +P 0.8	Des/Stylo Strip 38%	Des/Stylo Strip 8	Des/Stylo Strip +P -0.07
<b>Non-arable</b>	Stylo Strip 0.1	Stylo Strip 15%	Stylo Strip 19	Stylo Strip -0.06

## Discussion and conclusion

Establishing leucaena and Des/Stylo in strips were the most profitable options but success depends on the constraints each grazer faces (borrowing capacity, workload, climate, soil). Key considerations include better soils increase available options and profitability, applying phosphorus fertiliser increases profitability when it is a constraint, and successful establishment through planning and implementing suitable agronomic techniques is key to reducing risk. While establishing legumes increases short-term risk and may not be every graziers' solution, the potential economic rewards can be substantial.

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<sup>E</sup> Corresponding author: matthew.thompson@dpi.qld.gov.au

# Crops for Cattle – Increasing the efficiency of north Australian cattle production systems through strategies to improve dry season weight gain.

Tim Schatz<sup>A,C</sup>, Melissa Wooderson<sup>A</sup>, Zach Weir<sup>B</sup>

<sup>A</sup> NT DAF, Berrimah Farm, Darwin NT 0801; <sup>B</sup> NT DAF, Victoria River Research Station, NT 0851

## Introduction

The Crops for Cattle project aims to foster intensification of the northern cattle industry by integrating northern cropping and cattle production systems to increase weight gains in cattle during the dry season. A number of strategies aimed at improving dry season weight gain are being evaluated, and one of these strategies is feeding pellets to young cattle grazing native pasture.

## Methods

In early June in 2023 and 2024, Brahman weaner heifers were randomly allocated (stratified for weight) to two treatments; FED received Ridley® weaner pellets from early September to mid-November and CONTROL did not. The two groups had similar mean liveweights (LW) and the stocking rate matched the carrying capacity similarly in both paddocks. Weaner steers were used to meet the required stocking rates. The groups grazed in similar paddocks and were managed in the same way. Soyabean based pellets (31.8% protein) were fed at 0.6% of LW in 2023 and vegetable protein meal-based pellets (27% protein) were fed at 0.9% of LW in 2024. Liveweight was recorded after an overnight curfew at the start and end of the feeding period, and in May the following year.

## Results

The FED group gained 42 kg more LW than the CONTROL group over the 97-day feeding period in 2023, and 31 kg more than the CONTROL group over the 89-day feeding period in 2024. Liveweight gain in the FED group over the subsequent wet season was 12.6 kg more in the 2023-year group but 13 kg less than the CONTROL group in the 2024-year group. Overall, by May after the post-weaning wet season the FED group had gained 55 kg more than the CONTROL group in the 2023-year group and 18 kg more in the 2024-year group (Table 1).

**Table 1. Average weights (kg) at different times and total weight gained of the treatment groups.**

Year group	Treatment	Sept. Yr 1	Nov. Yr 1	May Yr 2	Total gained
2023	FED (N = 42)	188.0	240.0	343.2	155.2
2023	CONTROL (N = 50)	186.3	196.4	287.0	100.7
2023	<i>Difference (FED – CONTROL)</i>	<i>1.7</i>	<i>43.6</i>	<i>56.3</i>	<i>54.6</i>
2024	FED (N = 51)	188.5	249.6	340.4	151.9
2024	CONTROL (N = 67)	184.3	214.2	318.1	133.8
2024	<i>Difference (FED – CONTROL)</i>	<i>4.2</i>	<i>35.4</i>	<i>22.3</i>	<i>18.1</i>

## Discussion and conclusion

The cost of the pellets (excluding transport and labour) was \$1.21/kg in 2023 and \$0.74/kg in 2024. On average the FED animals consumed a total of 123.6 kg of pellets each in 2023 and 176.0 kg in 2024. At these feed prices, the cost of gain for the extra dry season LW gain was \$149.52 in 2023 and \$130.00 in 2024. Therefore, the cattle price would need to be above \$3.56/kg for the strategy to be profitable in 2023 and above \$3.67 in 2024. There was no wet season compensatory gain in the 2023-year group when the FED group gained 12.6 kg more than the CONTROL over the wet season, but there appeared to be some in the 2024-year group when the FED group gained 13 kg less than the CONTROL over the wet season. However, this result may be confounded by pasture type, as the 2024-year group grazed fresh pasture that had re-grown after a fire in the late wet season.

<sup>C</sup> Corresponding author: tim.schatz@nt.gov.au

# BeefVantage: Collaborative intelligence for better beef decisions

C.A. Wilson <sup>AE</sup>, U. Naseem <sup>B</sup>, R. Hay <sup>A</sup>, Z. Zhang <sup>C</sup>, H. Lu <sup>D</sup>

<sup>A</sup> James Cook University, Townsville, 4814; <sup>B</sup> Macquarie University, Sydney 2109; <sup>C</sup> University of Sydney, Sydney 2006, <sup>D</sup> Charles Darwin University, Darwin 0909

## Introduction

Beef production in Northern Australia faces complex challenges, including climate variability, pasture dynamics, genetics, animal performance, land management, and increasing demands for efficiency and sustainability. Although new research and innovations are continually produced, producers and advisors are often constrained by the time and cognitive effort required to locate, interpret, and apply relevant information. This can contribute to inconsistent advice and uneven engagement with new practices, given the time and effort producers must invest to assess what fits their enterprise. BeefVantage helps by easing this search and evaluation burden, giving users clearer access to the information they need to make informed decisions. Artificial intelligence (AI) presents an opportunity to streamline knowledge exchange and strengthen decision-making in the beef industry. However, generic AI tools carry risks, including inaccurate or fabricated outputs ('hallucinations'), lack of domain-specific context, and uncertainty around data provenance, which can undermine trust and reliability.

## Methods

BeefVantage is being developed by James Cook University and the TNQ Drought Hub as a tailored AI-powered assistant for the northern beef industry. The system applies large language models configured through a retrieval-augmented generation framework and agent-style processes to provide relevant, context-sensitive responses linked directly to source material. Development is iterative, with co-design involving extension officers and other users guiding interface design, content selection, and role-specific applications.

## Results

By reducing time spent searching across fragmented resources, BeefVantage helps streamline workflows and enables more timely, confident support. Early testing involved an evaluation exercise with 21 Queensland producers, extension officers, and advisors, who reviewed sample outputs and provided structured feedback. Participant feedback indicates that BeefVantage supports quicker access to reliable, source-linked information, improves preparation for producer engagement, and enhances advisory confidence. Ongoing development and validation efforts focus on accuracy, usability, and alignment with industry needs.

## Discussion and conclusion

BeefVantage represents a new form of collaborative intelligence: an AI assistant that complements rather than replaces human expertise. By grounding outputs in trusted industry knowledge, it reduces risks associated with generic AI tools and supports informed decision-making. Although extension officers are the first live pilot group, BeefVantage is being developed for the wider northern beef community, including producers, consultants, students, and researchers - with role-specific customisations to ensure information is relevant and actionable for each group. By streamlining access to trusted knowledge at the point of need, BeefVantage is poised to enhance capacity and deliver greater impact across northern beef production.

<sup>E</sup> Corresponding author: [carrie.wilson1@jcu.edu.au](mailto:carrie.wilson1@jcu.edu.au)

# Capture, engage and keep valuable people

Barbara Bishop<sup>A</sup>

Capacity in People Consulting T/A Barbara Bishop & Associates, Blackstone Qld 4304

## Introduction

Human capital, the knowledge, skills, abilities, and experience people bring to the business creates real economic value for a sustainable business. But because it is an intangible asset, it is often not managed or measured with the same discipline as tangible assets. Many businesses claim *“People are our most valuable resource,”* yet their balance sheet lists people only as a liability.

Jim Collins, in *Good to Great*, reminds us: *“People are not your most important asset; the right people are.”* (Collins 2001). Human capital management is the strategic approach to attracting, developing, managing, and retaining the right people to achieve business objectives.

In practice, a human capital management strategy can be built around CEAK: Capture, Engage, and Keep valuable people.

## Capture, Engage and Keep (CEAK)

**Capture** includes two elements, identifying the labour need and selecting the right person.

Labour needs include these considerations for the job or project. Labour hours. Tasks and outcomes to be achieved. Skills, experience and attitudes required. Package details. Attracting the right person. Selecting the right person requires interview preparation, structured interview process, careful decision making, checking past performance, and promoting the business quality and leadership.

**Engage** includes three elements, induction, defining and communicating roles and responsibilities and clarifying expectations.

Induction is a planned training program where the aim is to help employees settle into the business and become productive.

Defining and communicating roles and responsibilities provides employees with a clear definition and understanding of their role, function and responsibilities in the workplace.

Clarifying expectations means clearly communicating the performance standards employees must meet. It also requires recognition that employees have expectations of their workplace, and leaders must take time to understand these and determine how they can be met.

Once the right person has been captured and engaged, the task is to keep them. Retention is about ensuring employees believe your organisation is the best place for them. This is achieved by valuing their skills and experience, providing feedback and coaching, supporting the development of new and existing capabilities through training and professional development, and offering a realistic career path.

A final reflection. Does your organisation’s human capital management strategy capture, engage, and keep the right people to build a sustainable beef industry for the future?

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<sup>A</sup> Corresponding author: [barbara@barbarabishop.com.au](mailto:barbara@barbarabishop.com.au)

# Delivering outcomes for the Kimberley and Pilbara pastoral industry

*Bron Christensen<sup>A</sup>*

Kimberley Pilbara Cattlemen's Association, Broome 6725

## Introduction

The Kimberley Pilbara Cattlemen's Association (KPCA) was established to maximise the value of the northern Western Australian beef industry through innovation, capacity building and effective industry influence. Over the past decade, KPCA has evolved into the primary advocacy and best practice delivery body representing pastoralists across the Kimberley and Pilbara, working in close collaboration with the Western Australian Department of Primary Industries and Regional Development (DPIRD), the Pastoral Lands Board, and a wide range of local, national and international industry partners.

## Industry deliverables

Over the past three years, KPCA has delivered more than \$4 million in industry-funded projects focused on improving productivity, profitability and resilience across northern pastoral enterprises. Project delivery has targeted best-practice adoption in biosecurity, workforce development, financial and landscape planning, grazing and herd management, and diversification opportunities.

The association has also played a leading advocacy role on issues including pastoral lease rents, land condition assessments, carrying capacity methodologies, biosecurity (domestic and live export), cattle theft, illegal fires and pastoral land management.

## Outcomes

Significant outcomes include KPCA's leadership of the 2019 Pastoral Lease Rent Appeal, resulting in an average annual saving of approximately \$110,000 per northern pastoral lease through reduced rents and Shire rates. Collaboration with live export organisations and interstate advocacy bodies has contributed to a current independent scientific review of biosecurity vessel inspection requirements, with potential to significantly improve export efficiency and trade, particularly for tidal ports such as Broome and Wyndham. KPCA was an informed and vocal advocate for our pastoralists addressing the inequity in Western Australia's firearms legislation – an issue we continue to champion.

Key project achievements include delivery of strategic Landscape Evaluation and Financial Planning (LEAFlet) assessments to 30 pastoral businesses, providing pastoralist led identification of opportunities and financial implications; expansion of Aboriginal workforce development through the Aboriginal Pastoral Academy across the Kimberley and in the near future, into the Pilbara; utilised KPCA networks to identify and assist with individual pastoral station's involvement in DPIRD's Pilbara Extension Network; promotion of Emergency Animal Disease preparedness and response requirements at a wide range of industry and KPCA events and directly to management and staff at 47 stations across the Kimberley and Pilbara; support for regional fire planning hubs; delivery of industry tours and training programs including the APA industry immersion tour, legume study tour to Queensland, and a forthcoming live export industry tour to Indonesia ; raised carbon awareness and calculation strategies with pastoralists through facilitated carbon workshops; and implementation of targeted grazing, herd management and financial literacy initiatives with pastoralists through the current Kimberley NB2 group and the Pilbara NB2 program which will commence in 2026.

Annual flagship events managed by KPCA; the Livestock Handling Cup, Better Beef Business Forum and KPCA Conference—continue to grow in scale and reputation, strengthening industry capability and showcasing the Kimberley and Pilbara pastoral community.

<sup>A</sup> Corresponding author: ceo@kpca.net.au

# Campfire chat – the use of VR and AI technology in an Indigenous Peer to Peer learning group

Ian Perkins <sup>A,D</sup>, Fred Pascoe <sup>B</sup>, Cass Stevens <sup>C</sup>

<sup>A</sup> LPM Qld, Stanthorpe, Qld, 4380; <sup>B</sup> Bynoe Pastoral Company, Normanton Qld, 4890; <sup>C</sup> Thargomindah Station, Thargomindah, Qld, 4492

## Introduction

The Northern Beef Breeding Business (NB2) strategic partnership is a Meat and Livestock Australia (MLA) project driven by north Australian beef producers to address issues that threaten the long-term viability and sustainability of the northern beef industry. As part of the NB2 initiative, an Indigenous component of the project has been established through a process tailored to suit Indigenous property managers and communities. The NB2 Indigenous Peer to Peer learning group has been supported by MLA, The Indigenous Land and Sea Corporation (ILSC) and Animal Health Australia (AHA) and works with 8 to 10 participating organisations across Queensland. The group has developed a Virtual Reality tool to enable and facilitate story-telling and project evaluation, to develop oral Business Plans and to act as a live knowledge repository and source of information. Campfire chat combines Indigenous approaches to story-telling and knowledge sharing with innovative technology to develop a tool used in face to face meetings, to enable remote participation in Campfire Chat activities and to act as an accessible extension tool.

## Methods

Group members and VR specialists co-created VR learning tools in the first phase of the NB2 project to enable remote technical learning experiences. The project developed an Emergency Animal Disease Identification tool and other biosecurity learning tools and initiated the development of the Campfire Chat VR tool. The Campfire Chat VR tool has been further developed as an activity combining oral story-telling with innovative technology and high-level technical support.

Campfire Chat is integrated across all aspects of the project. The tool is used to enable oral participation in business plan and case study development, to facilitate story-telling and to record and provide project feedback and evaluation through interviews and oral recording.

## Discussion and conclusion

Indigenous people have been involved in the Australian cattle industry for over 100 years and while Indigenous enterprises manage over 300,000 head of cattle throughout Australia, across 10 million ha, Indigenous people are poorly integrated into the broader Australian cattle industry (Barnett 2022). Indigenous people are largely not involved with research and extension, policy and industry strategy development or producer level activities.

One of the strengths of the group to date has been the willingness to share and openness to learn from each other. The Campfire Chat builds on those strengths and is building a unique tool, taking advantage of opportunities offered by innovative technology and the involvement of engaged indigenous participants. This project and the Campfire Chat VR Tool have enabled Indigenous participants to re-engage with the industry on many levels to the benefit of the industry and the Indigenous participants. Oral knowledge recording, story-telling and information distribution are key to engagement and this project and these tools facilitate a level of interaction that incorporates Indigenous ways of doing and being.

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<sup>D</sup> Corresponding author: Ian Perkins: [ian@lpmqld.com.au](mailto:ian@lpmqld.com.au)

# Extension and adoption across the Gascoyne

Krystie Bremer<sup>A,B</sup>

<sup>A</sup> Gascoyne Pilbara Rangelands Initiative Inc. (GPRI)

## Introduction

In the Gascoyne region of WA, producers manage highly variable environments across large properties, requiring extension approaches that are practical, flexible and regionally grounded. To support adoption, extension activities have focused on research, tools and training aligned to locally identified needs. Emphasis is placed on shared learning and practical application, encouraging researchers and extension practitioners to ask questions first, co-design and consider how research is framed and communicated for producers managing variable conditions.

## Approach

Extension delivery across the region has involved workshops, peer learning activities, one-on-one support and community-based events across a large and remote pastoral region. This model recognises that producers have strong knowledge of their landscapes, livestock and markets. Key elements of this approach include:

- Connecting producers with researchers to discuss ideas in a practical, locally relevant context
- Bringing researchers into the region to support shared understanding and two-way learning
- Providing extension activities based on topics producers are actively seeking information on
- Delivering practical tools, templates, manuals and workshops applicable to individual businesses
- Working with the Northern Hub and PIP on regionally relevant programs.

## Results and outcomes

Extension that is informative, relevant and grounded in local experience is more likely to result in adoption. Workshops, peer to peer learning and one-on-one discussions have supported producers to explore new practices that suit their needs. Often, the strongest outcomes emerge through early engagement, regional buy-in, shared learning and peer-to-peer exchange. The provision of practical resources has been particularly valued by producers and project partners. Combined with direct connection to professionals who actively engage with producers and support learning there is ongoing engagement beyond individual events. A central outcome has been the ability to link local needs with broader programs and funding opportunities.

## Discussion and conclusion

In regional and remote pastoral systems, producers respond strongly when extension activities respect their knowledge and focus on practical decision-making. By applying established extension principles, learning becomes meaningful and adoption follows more naturally. A mix of workshops, peer learning and individual support allows producers to engage at different levels depending on their needs and readiness.

This approach has created opportunities to co-design future research and extension, and strengthens that research-extension/adoption connection. Strong partnerships with other organisations such as local Development Commission, the Northern Australia Drought Hub and the Pilbara Innovation Partnership (PIP) strengthen these outcomes by aligning regional priorities, funding opportunities and on-ground delivery.

Working collaboratively across local, regional and national programs builds producer capability, supports informed decision-making and encourages adoption suited to local landscapes and seasons. This reinforces that effective extension in rangeland systems is not about delivering answers, but about supporting better decisions through trusted, locally grounded engagement.

<sup>B</sup> Corresponding author: eo@gpri.org.au

# Adoption of innovation at scale through experiential learning

Claire Mahony<sup>A</sup>

Director IRDA Foundation, Managing Director Ceres & Co.

## Introduction

The National Farmers' Federation (2019) roadmap for agriculture to be a \$100 billion industry identifies several pillars for achieving the desired growth. Two of these pillars are 'Unlocking Innovation' and 'People and Communities'. The IRDA Foundation was established to enable retention of young people in industry and adoption of innovation at scale by facilitating experiential learning internationally.

## The process

The IRDA Foundation is built on the model of a networked not-for-profit (Wei-Skillern and Marciano, 2011) and focuses on developing a cohort of participants and a network of partners within the international innovation ecosystem as described by Budden and Murray (2019) and involving entrepreneurs, universities, government, corporates and risk capital. The programs established by the IRDA Foundation include internships between the US and Australia, innovation tours to the US for Australian producers and scholarships for the 44-Farms, Texas A&M International Beef Cattle Academy. These programs are supported by MLA Donor Company (MDC) project funding, direct sponsorship by start-up and scale-up companies and host producers acting in a venture client capacity. A venture client is a company that acts as a cornerstone client or early adopter of innovation and works closely with the start-up or scale-up company to co-design solutions that are fit-for-purpose and address a genuine problem statement for industry.

## Outcomes

Two scholarships were awarded in 2025 for Australian students to enrol in the 44-Farms, Texas A&M International Beef Cattle Academy. This program involves graduating at the Texas A&M Beef Cattle Short Course in August 2026. One Australian animal science student from the University of Queensland is undertaking an internship with R A Brown Ranch, Throckmorton, Texas from January to May 2026 and five interns from various US programs are completing their internships in Australia from May to August 2026. Projects being undertaken by interns range from analysing the value proposition of virtual fencing under different use cases to piloting in setting carbon markets within a beef value chain.

## The value proposition

There are several other programs or organisation in industry providing opportunities to share knowledge internationally, including Nuffield Australia and the Australian Beef Industry Foundation. The IRDA Foundation is unique in forming the direct relationships between hosts, sponsors and interns and building on that ecosystem to develop a broader network effect. The cohort of participants and their collective experience will create value for individuals, organisations and industry throughout the life of the foundation. The cohort will support incoming participants and continue to act as thought leaders on adoption of innovation across Australian and North American beef operations.

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<sup>A</sup> Corresponding author: [cmahony@ceresandco.com.au](mailto:cmahony@ceresandco.com.au); [info@irdafoundation.org](mailto:info@irdafoundation.org)

# Spatial survey to assess legume adoption in Queensland

Ian Dunbar<sup>A</sup>, Gavin Peck

Department of Primary Industries, Toowoomba 4350

## Introduction

Pasture legumes are the best long-term management option for increasing productivity and profitability from pasture-based production systems for large areas of Queensland. Previous reviews have concluded that successful legume adoption rates are low, particularly in some key biogeographic zones; however, there have been few studies that have quantified actual legume adoption rates at the regional scale and no survey at the Queensland scale. A spatial survey is being conducted to quantify the land area with pasture legumes across Queensland. This survey will provide information on where legumes have naturalised or been established by deliberate sowing across Queensland, and where there are limited amounts of pasture legumes. The results from the roadside survey will be combined with a spatial analysis of where legumes are suited and economic analysis to quantify the potential value of more widespread adoption of pasture legumes to the beef industry as part of the Queensland Pastures Resilience Program (QPRP).

## Methods

A survey is being conducted to spatially locate the distribution of legumes across Queensland. Measurements are taken at approximately 10-kilometre intervals along a given route, with road reserves and commercial paddocks measured separately. Roadside measurements are taken in areas that are undisturbed and represent the natural landscape (i.e. avoiding the disturbed areas). At each location; legume presence/absence, top 3 legumes by yield, legume density/composition rating, top 3 grass species by yield, grass competition, grazing pressure, pasture dieback symptoms, understorey vegetation and crown cover are recorded.

## Results

Initial results are derived from the Burnett, southern Darling Downs and Granite Belt regions of Queensland. An initial summary of results from the first round of legume adoption surveys is shown in

Table 2~~Error! Reference source not found.~~, focusing on the presence and absence of legumes and observed pasture dieback symptoms.

**Table 2: Summary of spatial survey results, with presence and absence of legumes categorised by land use and columns showing pasture dieback observations.**

Legume present/absent	Land Use	Dieback status			Total
		Clear symptoms	No visible symptoms	Potential symptoms	
<b>Absent</b>					<b>265</b>
	Crop (grain/fodder)	-	7	-	7
	Grazing	8	136	13	157
	Roadside	7	67	27	101
<b>Present</b>					<b>102</b>
	Grazing	1	28	10	39
	Roadside	8	47	8	63
Total		<b>24</b>	<b>285</b>	<b>58</b>	<b>367</b>

## Discussion and conclusion

Of the 367 surveys, 38.5% had legumes present; however, roadside data accounted for 61.8% of sites where legumes were present. Legumes were observed at only 21% of grazing locations. These initial results support the initial hypothesis that current successful adoption of legumes is low, and the opportunity to sow legumes to improve pasture performance is significant.

<sup>A</sup> Corresponding author: [ian.dunbar@dpi.qld.gov.au](mailto:ian.dunbar@dpi.qld.gov.au)

# Excel dry season pasture budget soon to be available on FutureBeef

Roger Sneath <sup>A,E</sup>, Greg Bath <sup>B</sup>, Nicole Sallur <sup>C</sup>, Bec Brayley <sup>C</sup>, Andrea McKenzie <sup>C</sup>, Rebecca Clapperton <sup>D</sup>

<sup>A</sup> Department of Primary Industries, Toowoomba 4350, <sup>B</sup> Department of Primary Industries, Brisbane 4163

<sup>C</sup> Department of Primary Industries, Charleville 4470, <sup>D</sup> Formerly DPI, Townsville 4810

## Introduction

An excel 'dry season pasture budget' calculator ('dry season' aka 'no or low growing season', or 'closed season') is being developed to be freely available on the FutureBeef website in 2026. For tropical and subtropical pastures in Queensland, pasture budgeting involves assessing the total amount of dry matter pasture that is grown over the growing season (i.e. parts of spring, summer and autumn) and then comparing available pasture dry matter yield to stock feed demand, aiming to ration the pasture out until the next pasture growing season, typically in summer. The aim is to also retain good ground cover of "rain ready" pasture stubble for when the next summer rainfall is expected in order to maximise infiltration, improve pasture response and minimise runoff and soil loss.

## Importance of pasture budgeting

Balancing stock numbers around long-term carrying capacity is important for maintaining land condition which is the foundation and one of the largest profit drivers for grazing businesses. Drought and overstocking are amongst the greatest risks to ground cover, land condition and grazing business resilience. Droughts can have devastating impacts on people, pastures, soil, stock, water resources, biodiversity, businesses and communities. Impacts of drought on ground cover also represent a large threat to the great barrier reef through poor water quality. Pasture budgeting over the "no or low growing" dry season (i.e. typically late autumn, winter, spring in Queensland) assists with adjusting stock numbers based on how much pasture feed has grown over the summer pasture growing season. Adjusting stocking rates is one of the most important grazing practices for managing drought and land condition. By assessing available pasture yield in autumn, it can be forecast if there will be enough feed to carry stock until an estimated "green date" when there is a reasonable probability of pasture growing rainfall and warmth to grow feed again. Graziers use experience and various methods of estimating sustainable stocking rates for their paddocks. A pasture budgeting calculator can add an extra tool to assist with balancing stock numbers with feed availability and retaining records.

## Whole of property pasture budget calculator – points of difference

Whilst there are various calculators available on the internet, some points of difference include:

- an excel calculator free to download from the FutureBeef website.
- allows for pasture budgeting for each paddock and for the whole property.
- caters for grazing multispecies within mobs (cattle, sheep, goats, horses, camels, kangaroos).
- uses AE's and DSE's for cattle, sheep and goats (McLennan *et al.*, 2020, McLean *et al.*, 2021).
- caters for up to 90 paddocks including three rotations per paddock over the "dry season".
- estimates the date when stock will graze the pasture down to hit the nominated residual pasture yield. It also shows how many tonnes of dry matter would be needed for stock until the end date. This helps with anticipating and planning for feed shortages well ahead of time.

## References

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<sup>E</sup> Corresponding author: roger.sneath@dpi.qld.gov.au

# Genetic tools to support fertile and productive cattle

Mehrush Forutan<sup>A,I</sup>, Bailey N. Engle<sup>A,B</sup>, Amanda J. Chamberlain<sup>C,D</sup>, Elizabeth M. Ross<sup>A</sup>, Loan T. Nguyen<sup>A</sup>, Michael J. D'Occhio<sup>E</sup>, Alf Collins Snr<sup>F</sup>, Elise A. Kho<sup>A</sup>, Geoffry Fordyce<sup>A</sup>, Shannon Speight<sup>G</sup>, Michael E. Goddard<sup>H</sup>, Ben J. Hayes<sup>A</sup>

<sup>A</sup> Queensland Alliance for Agriculture and Food Innovation, The University of Queensland, St Lucia, QLD; <sup>B</sup> USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE, USA; <sup>C</sup> Agriculture Victoria, Centre for AgriBiosciences, Bundoora, VIC; <sup>D</sup> School of Applied Systems Biology, La Trobe University, Bundoora, VIC, 3083; <sup>E</sup> School of Life and Environmental Sciences, Faculty of Science, The University of Sydney, Sydney, NSW; <sup>F</sup> Collins Belah Valley Brahman Stud, Marlborough, 4705, QLD; <sup>G</sup> Black Box Co, Mareeba, QLD; <sup>H</sup> University of Melbourne, Melbourne.

## Introduction

Fertility is one of the biggest profit drivers in beef cattle. Cows that get in calf early, calve regularly, and stay in the herd longer reduce replacement costs and improve overall productivity. However, fertility is one of the hardest traits to improve because it's affected by both the environment and genetics. Genomic technologies are helping us improve fertility traits. Instead of only tracking pedigree and performance, DNA tests can now tell us which animals are more likely to be fertile. Our study focused on finding the specific regions in the cow's DNA that influence female fertility, which could be incorporated into genomic testing tools.

## Methods

In this study, we combined fertility records from more than 27,000 beef cattle, including indicine, taurine, and crossbred animals. The traits we focused on were age at first calving, days to calving, pregnancy rate, and foetal age, as these are strong indicators of female fertility in the herd. We then linked this fertility data to DNA information, using whole-genome data, to search for genetic regions that consistently affect fertility. To add another layer, we also looked at gene activity in blood samples from 489 indicine cattle. This allowed us to see whether the same DNA variants linked to fertility also influenced gene activity, giving us greater confidence that these variants are functionally important.

## Results

From this analysis, we identified 225 regions of the genome associated with female fertility. Two regions stood out as particularly important, located on chromosomes 5 and 14. These regions include the genes *PLAG1* and *HMG2*. We also found that these genes are involved in both growth and reproduction, explaining why selection for fast growth can sometimes reduce fertility if not balanced properly. Another important discovery was a gene called *HELB*, which plays a role in reproductive ageing and DNA repair. In addition, several of the fertility genes we identified were more active during foetal development than in adult cattle, suggesting that fertility is influenced very early in life, long before a heifer reaches breeding age.

## Discussion and conclusion

The discovery of 225 DNA regions linked to female fertility provides a clearer picture of the genetic basis of reproduction in cattle. The strong signals on chromosomes 5 and 14, especially around the *PLAG1* and *HMG2* genes, confirm that fertility and growth are closely connected and breeding programs need to balance both traits to build herds that are not only heavier but also more fertile and productive. The identification of the *HELB* gene adds another important piece to the fertility puzzle. Its role in DNA repair and reproductive ageing suggests it could be a useful target for fertility-focused genomic tools. These markers have been incorporated into widely used SNP arrays, enabling more accurate identification of fertile heifers in the future. Equally significant is the finding that several fertility genes are most active during foetal development. This indicates that fertility potential is established long before a heifer reaches joining age and highlights the importance of good management of pregnant cows. Proper nutrition, health care, and low stress during gestation may influence the fertility of the next generation of breeding females.

<sup>I</sup> Corresponding author: m.forutan@uq.edu.au

# Using smart collars to help keep an eye on your bull team 24/7

Timothy Emery<sup>A,C</sup>, Thomas Williams<sup>B</sup>

<sup>A</sup>Department of Primary Industries, Roma, QLD 4455; <sup>B</sup>CQUniversity, Rockhampton, QLD 4700

## Introduction

Purchasing bulls is a significant investment and producers do their utmost to manage them to achieve successful reproductive outcomes. In recent years, producers have become increasingly curious about the sensor technologies becoming available e.g. Global Navigation Satellite System (GNSS) collars, to closely monitor their sires' movements remotely to determine breakdowns and risks to the joining.

## Methods

A Roma-based property, Echo Hills, demonstrated the use of GNSS collars (10 min frequency; Smart Paddock, Australia) on 4 of their bulls during the second half of the 2022/2023 joining period. Three Angus bulls (15-21 months old; W tags in Fig. 1) were monitored with 102 maiden heifers from 15 December 2022 to 26 January 2023 in a 200ha paddock with 2 water points. An Ultrablack bull (24 months old; R2546 in Fig. 1) over the same time period joined 3 other older bulls to service mixed age females in paddocks averaging 100ha (as part of a rotation) with 1 water point. A dashboard provided the host property with the opportunity to easily view individual animals along with heat maps during the monitoring period. CQUniversity conducted the analysis of the data collected by the GNSS collars, with the median distance travelled daily and active proportion based on time of day (hourly activity) being the focus of this work.

## Results

The median distance travelled per day varied across the 4 bulls (Fig. 1), with R2546 being the lowest at 1.98km and W25 the highest at 4.52km. W1 and W18 travelled 2.43km and 3.04km respectively. Daily distance differed significantly among bulls (Kruskal–Wallis;  $p < 0.001$ ). All 4 bulls were significantly more active at 0500 and 1700. R2546 was the most active of the 4 monitored bulls in the middle of the day and at 2200. Day-to-day stability (IQR/median) also differed: W18 showed the most stable pattern ( $\approx 0.28$ ), whereas R2546 and W1 were more variable ( $\approx 0.62$  and  $0.53$ ).

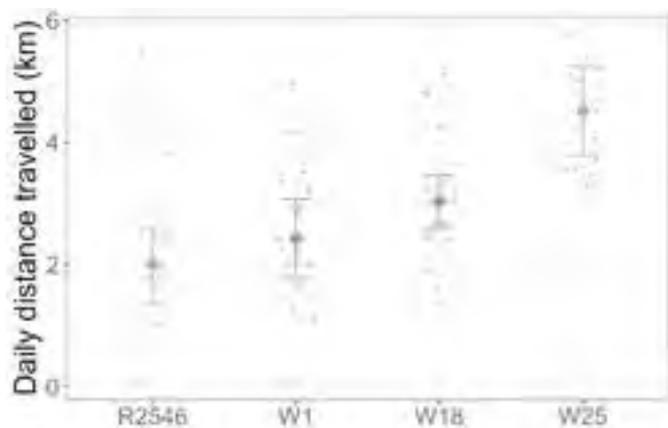


Figure 5. Median km travelled per day for 4 bulls from 15 December 2022 to 26 January 2023.

## Discussion and conclusion

W1 was noticed with a swollen pastern on 21 December 2022 and R2546 was run in a smaller paddock, which may have contributed to the lower distance travelled. This context aligns with the observed day-to-day variability, and reduced distances travelled by W1 compared to his counterparts, suggesting that injury may partly explain their patterns. The bimodal pattern of activity at dawn and dusk was predicted and clearly evident. Practically, simple dispersion metrics (for example, IQR/median) could be used to flag bulls deviating from “normal” and prompt inspection. Future work should prioritise capturing activity for the entire joining period and incorporate DNA testing for parentage and determining correlations.

<sup>C</sup>Corresponding author: timothy.emery@dpi.qld.gov.au

# Automated, remote detection of oestrus in grazing cattle using CERES TAG sensors

Greg Campbell<sup>A</sup>, Doug Carmichael<sup>A,D</sup>, Aaron Ingham<sup>B</sup>, Neil Bagnall<sup>B</sup>, Jody McNally<sup>B</sup>, Greg Bishop-Hurley<sup>B</sup>, Reza Arablouei<sup>C</sup>, Brendan Do<sup>C</sup>

<sup>A</sup> CERES TAG Pty Ltd, Brisbane, QLD 4030; <sup>B</sup> Agriculture and Food, CSIRO, St Lucia, QLD 4067; <sup>C</sup> Data61, CSIRO, Pullenvale, QLD 4069

## Introduction

Oestrus detection in cattle provides essential information on reproductive status, including age at puberty and indicators of pregnancy or cycling activity. Detecting oestrus in extensively grazed cattle remains challenging due to large paddock sizes, limited human observation, and the subtlety of behavioural cues. Early identification of heifers reaching puberty helps optimise breeding programs. In grazing systems remote, reliable detection of oestrus is vital for managing herd fertility and improving reproductive efficiency.

## Methods

A joint CSIRO and CERES TAG field study monitored *Bos taurus* cattle undergoing both natural and hormonally induced oestrus cycles. Oestrus events were identified using Kamar Heat Detectors, verified by blood progesterone analysis. Each animal was fitted with a CERES TAG sensor, which continuously recorded behaviour and activity parameters. Data were analysed to determine whether changes in behaviour correlated with confirmed oestrus events.

## Results

Distinct behavioural patterns were observed during oestrus, namely increased walking activity and reduced grazing and resting periods in the 12–24 hours preceding oestrus. Analysis comparing algorithm results with verified oestrus and non-oestrus events demonstrated high reliability with a Matthews Correlation Coefficient (MCC x100) of  $93.84 \pm 1.25$  at the optimal predictive threshold (Table 1). Given the high replicability and comparatively low processing overheads, it was subsequently deemed achievable to operate this algorithm 'on the edge' using CERES TAG sensors, enabling automated, remote notification of oestrus events without manual observation.

**Table 1. Mean  $\pm$  SD (Standard Deviation) across 1,000 independent runs for precision, recall, F1, and MCC ( $\times 100$ ) at the default ( $\tau = 0.5$ ) and optimal ( $\tau = 0.6232$ ) thresholds.**

threshold	class	precision	recall	F1 score	MCC
0.5	oestrus	$94.92 \pm 1.46$	$92.63 \pm 0.65$	$93.76 \pm 0.80$	$93.40 \pm 0.85$
	non-oestrus	$99.56 \pm 0.04$	$99.70 \pm 0.09$	$99.63 \pm 0.05$	
0.6232	oestrus	$96.70 \pm 1.71$	$91.72 \pm 1.34$	$94.14 \pm 1.18$	$93.84 \pm 1.25$
	non-oestrus	$99.51 \pm 0.08$	$99.81 \pm 0.10$	$99.66 \pm 0.07$	

## Discussion and conclusion

These results demonstrate the capability of CERES TAG to detect oestrus in grazing cattle with high accuracy. Implementing such systems can improve herd reproductive performance and reduce productivity losses. Accurate detection of oestrus allows producers to identify age of puberty in heifers, enabling selection for earlier-maturing, more fertile females and timely culling of late cycling heifers. Automated oestrus detection using CERES TAG therefore provides producers with a practical tool to enhance reproductive management, genetic progress, and profitability in extensive grazing systems.

<sup>D</sup> Corresponding author: [doug.carmichael@cerestag.com](mailto:doug.carmichael@cerestag.com)

# Virtually fencing cattle onto new water points in Northern Australia

Christie Pearson <sup>A,C</sup>, Anita Chang <sup>B</sup>

<sup>A</sup> Northern Territory Department of Agriculture and Fisheries, Katherine, NT 0850; <sup>B</sup> Institute for Future Farming Systems, Central Queensland University, Rockhampton, QLD 4701

## Introduction

Virtual fencing (VF) may offer novel ways to control animal movement for remote grazing management and to reduce labour and infrastructure costs (Muller & Spiegel, 2025). Although VF has been used successfully to manage livestock in intensive systems, its use in large-scale extensive systems of Northern Australia is less well understood and has not been widely demonstrated. Adding additional water points in large paddocks is common in Northern Australia, and it is not well documented how animals utilise and interact with new water points. This trial assessed the effectiveness of VF keeping cattle on a new water point within a familiar paddock, and to document water point preferences of animals after the VF was removed after a 4-week period.

## Methods

Gallagher eShepherd VF collars were fitted to 100 non-lactating cows grazing in a 2200ha paddock near Katherine, NT. Animals were trained for 6 days in a 5ha temporary paddock to learn the VF boundary cues. They were then walked 3.3 km to a new water point, held on the new water for 30 minutes and released within the virtual boundary, which ranged between 1.5 and 4.6km from water. The boundary remained in place for 4 weeks. VF neckbands were removed at 4 weeks and Smart Paddock GPS tracking collars were fitted to the same animals to monitor visitation at the two water-points. Visitations within 200m of each watering point were calculated in R using the `distHaversine` function (geosphere package; Hijmans, 2024).

## Results

The majority of the cattle (99%) stayed within the virtual boundary over the 4-week trial period (Table 1). Two animals went outside the boundary for a short time, but returned within the boundary limit after the 'return to paddock' function was activated. In the 4 weeks after VF collar removal the percentage of animals watering at the new water point declined from 55% in week 1 to 5% in week 4.

**Table 1. The percentage of animals at each water point during and after the virtual fencing. Only animals with GPS data for length of trial were included in the visitation analysis (n=88).**

	During VF trial	Wk 1 after	Wk 2 after	Wk 3 after	Wk 4 after
New water	99%	55%	29%	9%	5%
Old water	1%	40%	59%	81%	96%
Not recorded*	NA	5%	12%	10%	0%

\* Visitation for some animals may not be recorded due to GPS interval being too long. Where visitations sum is more than 100%, some animals may have visited both waters on the same day.

## Discussion and conclusion

This study demonstrated that VF can effectively modify behaviour and encourage cattle to use new water points and surrounding grazing areas, with 99% of cows remaining in the virtual boundary. However, it also demonstrated the dominant effect of habitual behaviour on grazing patterns and suggests that to redirect cattle from established habits and encourage consistent use of new water points, producers are likely to require adopting proactive management strategies.

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<sup>C</sup> Corresponding author: [christie.pearson@nt.gov.au](mailto:christie.pearson@nt.gov.au)

# Updating the life cycle carbon assessment of Australian livestock exports

*Stephen Wiedemann<sup>A</sup>, Luke Neale, Lauren Walker, Shilja Shaji, Riley O'Shannessy, Jordan Peach*

Integrity Ag, Toowoomba, QLD, Australia

## Introduction

The Australian livestock export industry plays a critical role in supplying protein to markets with processing constraints, limited cold-chain capacity, or strong consumer preferences for freshly processed meat. To meet Australia's greenhouse gas (GHG) reduction targets, the sector must demonstrate its environmental credentials. This study updated the 2011 life cycle assessment of cattle and sheep exports to provide a current benchmark of carbon footprint, fossil energy use, and freshwater consumption, including, for the first time, air freight.

## Methods

The assessment covered cattle and sheep supply chains from on-farm production through quarantine yards and shipping to port of arrival, with Scope 3 upstream emissions and a downstream Indonesian feedlot case study. Updated GHG accounting methodologies and water indicators were applied to improve comparability. Impacts were expressed per kilogram of liveweight (LW) and per head-day (hdd).

## Results

Weighted average emissions during export (quarantine to destination port) were 17.1 kg CO<sub>2</sub>-e hdd<sup>-1</sup> for cattle and 4.8 kg CO<sub>2</sub>-e hdd<sup>-1</sup> for sheep. Fossil energy use was 149.6 MJ hdd<sup>-1</sup> and 56.3 MJ hdd<sup>-1</sup>, and freshwater consumption 33.2 L hdd<sup>-1</sup> and 8.3 L hdd<sup>-1</sup>, respectively. Compared with 2010, this is a decrease of 30% for cattle emissions, mainly from reduced fuel use, and an increase in sheep emissions, reflecting lower stocking densities on ships. Air freight had disproportionately high emissions and energy use, though it remains a small trade pathway. The Indonesian feedlot case study showed only a 12% higher carbon footprint than Australian slaughter cattle, indicating relative efficiency.

## Discussion and conclusion

The livestock export component contributes a small proportion of total supply chain emissions (≈4% for cattle, 25% for sheep) but a larger share of energy use. Improvements in cattle production efficiency have reduced emissions intensity since 2010, while welfare-related shipping requirements increased impacts for sheep. Future opportunities to reduce emissions include improved ship energy efficiency and feed-based methane mitigation. This benchmark provides a foundation for industry sustainability reporting and progress tracking.

<sup>A</sup> Corresponding author: [stephen.wiedemann@integrityag.net.au](mailto:stephen.wiedemann@integrityag.net.au)

# Developing sustainable carrying capacities in the Victoria River District of the Northern Territory

K. Holzapfel<sup>A</sup>, J. Eastaughffe, C. Pettit, and R. Cowley

NT Department of Agriculture and Fisheries, Berrimah 0828

## Introduction

Matching stocking rates to the long-term carrying capacity of a paddock helps maintain land condition and supports consistent animal productivity through variable rainfall years. Carrying capacity provides a benchmark for the number of animals a paddock can support sustainably, based on the amount of pasture expected to grow in a median rainfall year. It is estimated by combining pasture growth, safe utilisation rates and animal intake requirements.

Pasture growth for this benchmark can be estimated using the GRASP pasture growth model (Rickert *et al.*, 2000). GRASP is calibrated with data collected from fenced exclosures known as SWIFTSYND sites where ungrazed pasture growth and soil data are measured over two or more years. Each site represents a unique land type and once calibrated, the model can be run for different locations using site specific rainfall data to estimate median pasture growth.

Current GRASP models exist for some land types, but large gaps remain, limiting the ability to provide consistent, region-wide carrying capacity guidance. Existing vegetation and land system mapping has not been available at a scale or in a format that clearly identifies areas with similar pasture production potential. To overcome this, the existing mapping has been redefined into Grazing Land Management Units (GLMU), which group areas of comparable pasture growth capacity. This framework identified where GRASP models already exist and importantly, where new models are needed.

## Methods

Twenty-seven GLMUs were defined for the Victoria River District (VRD) by grouping landforms with similar pasture production potential. The GLMUs guided the selection of four new SWIFTSYND sites to address under-represented and widespread land types including colluvial, ferruginous, and cracking clay land units in the far north and far south of the VRD.

The four 30 m x 30 m SWIFTSYND sites were fenced with ring-lock fencing to exclude all grazing. FarmBot rain gauges and cameras have been installed at each site to collect daily rainfall data and provide a visual reference for new pasture growth. Pasture growth and soil data will be collected using the SWIFTSYND methodology described by Day and Philp (1997). Data will be used to calibrate the GRASP pasture growth models for each GLMU.

## Results and discussion

Although field data collection has only recently begun, the project is designed to deliver a comprehensive carrying capacity guide for each GLMU in the VRD region. This guide will serve as a best practice resource to support the pastoral industry in setting sustainable stocking rates at a paddock and property level. The Sustainable Carrying Capacity project is a collaboration between the NT Department of Agriculture and Fisheries (DAF), the NT Department of Lands, Planning and Environment (DLPE), and the Australian Department of Agriculture, Fisheries and Forestry through the National Soil Action Plan.

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<sup>A</sup> Corresponding author: Kate.Holzapfel@nt.gov.au

# Tracking reveals cattle group into spatial and social clusters, but performance does not differ between groups

Thomas Williams<sup>A,C</sup>, Timothy Emery<sup>B</sup>

<sup>A</sup> CQUniversity, Rockhampton, QLD 4700; <sup>B</sup> Department of Primary Industries, Roma, QLD 4455

## Introduction

In extensive beef breeding systems, everyday movement and association patterns of cattle are rarely measured directly, yet they shape access to feed and influence energy expenditure, with potentially significant downstream effects on performance. Studies in growing cattle show behavioural and dietary differences between high- and low-gain groups, but measured factors explain only part of the variation, highlighting the value of objective behavioural data (Charmley et al., 2024). GPS biotelemetry provides continuous, observer-independent records of movement and space use, allowing inference on activity budgets, range occupancy and social association. This study monitored cows near Roma, Queensland to test whether unsupervised analyses of movement and proximity reveal discrete behavioural and social groupings and whether these align with performance indicators.

## Methods

Fifteen Angus-cross cows from the cohort were fitted with GNSS (Global Navigation Satellite System) collars (10 min frequency; Smart Paddock, Australia) from 15 December 2022 to 30 March 2023. Per-animal movement features were derived (step length, speed, activity, routine regularity, time in core, range size), and a proximity network was built using co-locations. Features clustered using unsupervised methods. Movement data were summarised using PCA; the first component (PC1) was used as an overall movement score. Associations of movement clusters, social clusters, and PC-based movement scores with body condition score category (high vs low; BCS) and progeny average daily gain were tested.

## Results

Clustering identified two distinct movement groups ( $n = 13$  and  $n = 2$ ; mean silhouette = 0.699). The smaller group was markedly sedentary, characterised by lower speed and activity, reduced range size, greater concentration in a core area, and more consistent daily routines (e.g. speed 0.015 vs 0.051 m s<sup>-1</sup>; KDE95 51 vs 248 ha; time in core 0.316 vs 0.113). Social network analysis also produced two groups of the same composition (13 and 2), though contrasts were milder and concordance with movement-based groups was limited (adjusted Rand index = 0.335). Neither movement or social clusters were associated with BCS or average daily gain, with all tests non-significant (movement:  $p = 0.524$  and 1.000; social:  $p = 1.000$  and 1.000). Similarly, a principal component summarising movement features showed no difference by BCS or growth ( $p = 0.679$  and 0.295).

## Discussion and conclusion

The analysis revealed a small but distinct dichotomy in spatial behaviour within the cohort. Most cows were wide-ranging and moderately active, while a minority were comparatively sedentary. Social structure reflected a similar gradient but did not align fully with movement, indicating that associations are shaped by factors beyond movement, such as resources or individual preference. Neither movement, social clusters, or composite movement index related to BCS or calf growth. These findings suggest that GNSS-only subset data are insufficient for grouping animals by typical production metrics. Future work should prioritise full-cohort coverage and integration of additional sensors, such as accelerometers, to better link behavioural heterogeneity with productivity outcomes.

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<sup>C</sup>Corresponding author: [t.m.williams@cqu.edu.au](mailto:t.m.williams@cqu.edu.au)

# Field prototype for oral sample collection in grazing ruminants

Chian Teng Ong <sup>A,C</sup>, Tony Cavallaro <sup>A</sup>, Marina Fortes <sup>B</sup>, Elizabeth Ross <sup>A</sup>

<sup>A</sup> QAAFI, University of Queensland, St Lucia 4072; <sup>B</sup> SCMB, University of Queensland, St Lucia 4072

## Introduction

Rumination allows the capturing of rumen microbes in the oral cavity, hence the oral microbiome has been proposed as a proxy for rumen-microbiome related trait measurement, including feed efficiency (Marcos et al., 2024) and subacute rumen acidosis (Liu et al., 2025). Oral sampling is a minimally invasive alternative to existing sampling methods, for example ruminal fistulation, stomach tubing, or rumenocentesis, which are invasive and impractical in commercial settings. This study reports the use of a prototype for ruminant oral sample collection in an extensive grazing setting.

## Methods

A total of 218 animals from 3 cattle stations were included in this study. Oral samples were collected using an in-house swab prototype consisting of a disposable plastic plier and cotton sponge stick (Figure 1). Each animal was restrained in a crush, weighed, and sampled by brushing the swab across the buccal surface, sublingual area, and palate for ~60 seconds. DNA was extracted and sequenced to characterize the oral microbiome composition as described by Ong et al., (2025).



Figure 6: Oral sampling prototype

## Results

The amount of DNA obtained from oral samples ranged from 2.54 to 188 ng/ul (Table 1) in a total volume of 50µL. All samples, including those with the lowest DNA concentrations, met the minimum DNA requirement for sequencing (100 ng). Variation in DNA concentration among the oral samples was reflected in the sequencing output, which ranged from 954.55 to 7099.65 Mb. On average, 90% ± 0.8% of the sequencing reads in the oral samples collected in this study were of cattle origin. After removal of host reads, the non-host sequence data ranged from 15.70 to 2,701.44 Mb. Inconsistencies were observed in both extracted DNA concentrations and sequencing output, before and after host read removal, with coefficients of variation exceeding 30%.

**Table 1.** The amount of DNA, total bases before and after host data removal.

Step	Lowest	Highest	Average ± SD	Coefficient of Variation
DNA conc (ng/ul)	2.54	188	43.99 ± 28.90	0.66
Total bases from sequencing (Mb)	954.55	7,099.65	2138.30 ± 1007.49	0.47
Total bases after host removal (Mb)	15.70	2,701.44	226.33 ± 274.08	1.21

## Discussion and conclusion

These findings are consistent with previous studies, which suggest that collecting oral samples at specific time points or using swab colour as an indicator after collection may improve DNA yield. Nonetheless, these suggestions may not be practical for extensive grazing farms with infrequent mustering. The proposed tool is very cost effective, and the host DNA collected can also be used for genotyping the animal. Further analyses are needed to determine whether downstream sample normalisation can mitigate the limitations of inconsistent DNA concentrations and sequencing outputs, thereby enabling the data to be reliably used for assessing rumen-related traits.

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<sup>C</sup> Corresponding author: chianteng.ong@uq.edu.au

# The FORAGE system – the ‘track record’

G Stone <sup>A</sup>, J Barnetson, D Bruget, J Carter, G Fraser, S Irvine, B Zhang B, X Zhang, S Yuan

Queensland Department of the Environment Tourism, Science and Innovation, Ecosciences Precinct, Dutton Park, Queensland, Australia.

## Introduction

Since the late 2000s, the FORAGE system (Timmers *et al.*, 2008; Zhang and Carter, 2018) has provided Queensland land managers, extension providers and consultants with high-quality, meaningful property-scale data and imagery. This information is site-specific and tailored to facilitate on-ground management decisions relating to sustainable grazing land management. An update of the products currently available is provided here along with user statistics and user experience research.

## Methods

The FORAGE system accesses complex datasets, mapping, satellite imagery and processes calculations on high performance computing infrastructure. User-defined data and imagery are incorporated into ‘customised and themed’ templated PDF reports for an area of interest (> 1 ha) for delivery by email. Reports are requested from an easy-to-access online portal (via lot/plan or address entry, clickable map, or shapefile). The MyFORAGE online mapping tool has been developed for users to have an interactive interface to input further information for their property (or paddock) to enhance FORAGE report content.

## Results

Report request numbers for the 14 customised reports (number recording began in 2011) total over 333,000 reports (≈4,500 per month for 2025) delivered to more than 8,500 users. Report area and frequency statistics were derived (2020–2024), with property request spatial distribution across Queensland accounting for >80% of Queensland’s land area. Furthermore, over a 12-month period (July 2024 – June 2025), FORAGE reports were requested for over 47% of the Queensland Reef catchments area. Actionable insights from user experience social research regarding the usage, usability and perceived usefulness of the reports are provided by McCartney *et al.*, (this conference).

Clients can also set a subscription interval to receive selected reports regularly (e.g. 1–3 monthly) to ensure information is at hand when required for decision making. In addition, spatial GeoPDF files are included for several selected report map images which can be uploaded to mapping applications on devices such as tablets and mobile phones for onsite property applications.

## Discussion and conclusion

The FORAGE system is a unique extension service with a proven ‘track record’ that can inform stakeholders and assist in decision-making. New reports (e.g. a ‘Feed Budget Report’) are in development and under testing with landholder collaborators. Continuous improvement within the system (i.e. updated satellite data, modelling advances), and report content (from user experience and social science research) enhance report data quality, appearance and delivery. The FORAGE system makes complex historical, modelled and remotely-sensed data and imagery more accessible and relevant to a range of stakeholders – providing a valuable information resource and saving users’ time and effort in a ‘time-poor’ world.

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<sup>A</sup> Corresponding author: Grant.Stone@detsi.qld.gov.au

# Reducing barriers to agriculture technology adoption through innovation-readiness assessments

K.G Worth <sup>c</sup>

James Cook University, Cairns, 4878

## Introduction

Research on technology adoption decisions among producers considers availability of information (Marra *et al.*, 2003), skills and technical factors (Koech *et al.*, 2021) as contributing barriers to uptake. This introductory evaluation considers *AgValuate* as a purpose-built tool to address adoption barriers by improving clarity, accessibility and actionability of information to accelerate adoption.

## Methods

*AgValuate* is an innovation-readiness assessment tool developed by the Tropical North Queensland Drought Hub (TNQ Hub) in 2022 to support primary producers in evaluating the fit of technology and innovation within their farming enterprise. The tool was designed using an iterative co-design process with producers and extension professionals to enhance the responsible uptake of technology. Key design features include a 'now' and 'aspired to' readiness scale displayed as a radar chart, immediate farm-specific reports and links to adoption support pathways embedded within the TNQ Hub 'adoption pipeline'. This evaluation draws on descriptive use metrics (280 users since launch) and a design review against extension and adoption research, focusing on clarity, accessibility and actionability to provide an initial assessment of the appropriateness of the tool for technology adoption.

## Results

Since the launch of the first iteration in 2023, 280 users have completed an *AgValuate* assessment. Uptake has grown exponentially over time, with independent online access accounting for majority of use following initial workshop-based introduction in 2023-2024. The tool aligns with key best practice standards in extension and agriculture technology adoption research. It demonstrated clarity of information in a visual format through the radar chart, allowing users to interpret gaps and growth areas at a glance. Accessibility was evident through design in online and offline contexts, short completion time (average 5-10minutes) and the provision of outputs in plain but relevant language, suitable for diverse contexts and users. Actionability was delivered through immediate, personalised, farm-specific reporting that highlighted priority areas and provided follow up support through the TNQ Drought Hub's adoption pipeline and technical support.

## Discussion and conclusion

Early evaluation suggests *AgValuate* has achieved strong reach while aligning with established extension and adoption principles. By reducing barriers through short completion time, plain language reporting and both online and offline access, the tool increases accessibility and usage across a broad range of user profiles. The radar chart format enhances visual clarity by making readiness gaps immediately observable, supporting rapid self-assessment and informed decision-making. Actionability is strengthened through embedded support pathways, positioning *AgValuate* as a practical mechanism for connecting producers with meaningful support. This positions the tool as a scalable medium for advancing early-stage technology adoption among Australian producers, with potential to further reduce barriers in innovation uptake.

## References

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<sup>c</sup> Corresponding author: [Kara.worth@jcu.edu.au](mailto:Kara.worth@jcu.edu.au)

# Unlocking a new source of income in livestock production: Literature review

Elieder Prates Romanzini <sup>A,B</sup>, Sarah Mcilveen <sup>A</sup>, Mark Peart <sup>A,C</sup>

<sup>A</sup> DIT AgTech, Toowoomba Qld 4350

## Introduction

Ruminant livestock systems have traditionally relied on income from stock sales and the production of meat, milk, wool, and manure. However, increasing concerns about global warming have created new revenue opportunities through the mitigation of greenhouse gas (GHG) emissions, through carbon markets. In Australia, the agricultural sector produces an estimated 85 MtCO<sub>2</sub>e — around 15% of national emissions, excluding LULUCF (land use, land-use change, and forestry) — with approximately 57% of these emissions originating from enteric fermentation in ruminant livestock systems (Australian Government, 2022; Pelekh *et al.*, 2023). Consequently, reducing enteric methane emissions is an important strategy for achieving carbon neutrality and generating additional income for livestock producers.

## Current scenario

Australia's total livestock population is approximately 30 million head of cattle, 79 million head of sheep, and an unquantified number of goats. According to the IPCC (2019), the emission factors for cattle (dairy and other cattle), sheep, and goats in Oceania are as follows: 93 kg methane (CH<sub>4</sub>) per head per year for dairy cattle, 63 kg CH<sub>4</sub> per head per year for other cattle, and 9 or 5 kg CH<sub>4</sub> per head per year for small ruminants under high- or low-productivity systems, respectively.

It is important to highlight that in the carbon market, the standard unit of measurement is tCO<sub>2</sub>e (tonnes of carbon dioxide equivalent). To convert methane emissions to CO<sub>2</sub>e, the Global Warming Potential (GWP) of methane is applied, which involves multiplying CH<sub>4</sub> emissions by 28. Therefore, one tonne of CH<sub>4</sub> is equivalent to 28 tCO<sub>2</sub>e. Pelekh *et al.*, (2023) mentioned that assuming meat and dairy production remain at 2019 levels, Australia's livestock sector emissions could decrease by 6 MtCO<sub>2</sub>e compared to 2019, representing a 10% reduction in enteric fermentation emissions and a 9% reduction in manure management emissions. The 6MtCO<sub>2</sub>e reduced could then be commercialised on the voluntary carbon market (VCM). The VCM enables organisations and individuals to purchase or sell carbon credits voluntarily to offset emissions, whereas compliance markets operate under legal obligations, requiring entities to meet mandated emissions reduction targets through the surrender of credits. VERRA is a leading standard-setting organisation in the voluntary carbon market (VCM). It develops and manages frameworks, such as the Verified Carbon Standard (VCS), to ensure that carbon credits are credible, additional, and verifiable, providing transparency and trust for buyers and project developers. Therefore, if a livestock producer implements a project under a VERRA methodology, the farm would be able to commercialise carbon credits resulting from the practices adopted, in accordance with the relevant VERRA methodology, within a specified timeframe.

## Conclusion

Use of the VCM is now well established across various industries. However, the availability and adoption of VERRA methodologies in the livestock sector remains limited. Companies such as DIT AgTech are working continuously to facilitate the adoption of these methodologies, via easy-to-use technology, enabling livestock producers to access this emerging market. This creates a new revenue stream associated with sustainable production systems that reduce greenhouse gas (GHG) emissions, driving adoption and helping to achieve the carbon neutrality proposed by the Australian Government.

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IPCC (2019). 2019 Refinement to the 2006 IPCC - Guidelines for National Greenhouse Gas Inventories.

<sup>B</sup> Corresponding author: [eli@ditagtech.com.au](mailto:eli@ditagtech.com.au); <sup>C</sup> Presenter author: [mark@ditagtech.com.au](mailto:mark@ditagtech.com.au)

# Production potential of improved pastures on northwest Queensland Downs

Jane Evans <sup>A,C</sup>, Colin Burnett <sup>B</sup>

<sup>A</sup> Department of Primary Industries, Cloncurry 4824; <sup>B</sup> Lara Downs, Julia Creek, Qld 4823

## Introduction

Establishing improved grasses and legumes on heavy clay soils in northwest Queensland has the potential to contribute to pasture and beef business resilience (Bowen *et al.*, 2015). The opportunity to evaluate the production potential of grazing improved pastures compared to undeveloped Mitchell grass downs arose within an on-property leucaena production paddock north of Julia Creek (Qld).

## Methods

Improved perennial legume and pasture species suitable to heavy cracking clay soils (Table 1) were sown between the rows of raised beds supporting leucaena across a 17 ha plot in January 2023. Pasture composition was monitored annually post wet season with a minimum of 60 inter-row sampling points recorded for botanical analysis. Induction and exit weights of mixed-sex Droughtmaster weaners were recorded from 35 head grazing the site and 22 control animals on Mitchell grass downs over 56 days (April to June 2024). The site was spelled, opened into an additional 40 ha paddock and grazed with 43 mixed-sex Angus weaners for 73 days (May to July 2025). Ten control animals were also inducted.

## Results

The site received above average rainfall for the 3 wet seasons post planting. End of wet botanical analysis recorded Flinders grass as the dominant pasture species in all years. This was followed by Rhodes and non-legume dicots in May 2023, Mitchell and Rhodes in March 2024 and Mitchell and desmanthus in June 2025. While Buffel was observed on site, desmanthus, Caatinga stylo and Angleton grass were the only sown species sampled 2.5 years post planting, accounting for 21%, 9.9% and 1.8% of the total pasture yield, respectively (Table 1). From April to June 2024, the treatment and control paddock liveweight gains (LWG) were 2.05 kg/ha/day and 0.14 kg/ha/day, respectively. In 2025, the control mob was missing upon exit, but the treatment LWG was 0.4 kg/ha/day from May to July.

**Table 1. Contribution of sown pastures to production paddock pasture yield post wet season.**

Improved pasture type	% DM yield (May 23)	% DM yield (March 24)	% DM yield (June 25)
Tolgar Rhodes	22.6%	9.2%	-
Bambatsi panic	0.6%	0.1%	-
Marc desmanthus	0.2%	8.6%	21%
Angleton grass	0.1%	-	1.8%
Biloela buffel	-	1.3%	-
Butterfly pea	-	0.04%	-
Caatinga stylo	-	0.6%	9.9%

## Discussion and conclusion

Low and diminishing yields of the improved grasses after 3 above average wet seasons emphasises the difficulty in establishing these species in northwest Qld. However, the sown legumes were successful in establishing and persisted under periodic grazing to compliment the native grasses and leucaena within the production paddock. From April to June 2024, higher stocking rates enabled the improved pasture paddock to produce 1.92 kg/ha/day LWG more than the Mitchell grass downs paddock. This demonstrates the benefit of periodically utilising a production paddock in northwest Qld. Further evaluation of the production potential of grazing improved pastures compared with undeveloped Mitchell grass downs should be assessed into the dry season as pasture quality declines.

## References

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<sup>C</sup> Corresponding author: jane.evans@dpi.qld.gov.au

# Spatial analysis of legume suitability in Queensland

Vanessa Macdonald<sup>B</sup>, Gavin Peck

Department of Primary Industries, Toowoomba 4350

## Introduction

Pasture legumes are recognised as the best long-term management option for increasing productivity and profitability from pasture-based production systems for large areas of Queensland. However, the land area that is suitable for pasture legumes across Queensland has not been well quantified. This study is currently underway to quantify the area that is suited to the most widely suitable and used pasture legume species using updated spatial data including land resource and long-term climate mapping, compared to trial results and commercial experience of where legumes are suited.

The results from this spatial analysis of where legumes are suited will be compared to a spatial survey and analysis of where legumes are established and naturalised, combined with an economic analysis to quantify the potential value of more widespread adoption of pasture legumes to the beef industry as part of the Queensland Pastures Resilience Program (QPRP).

## Methods

Five legume species were identified as being the most widely adapted and therefore most likely to have a large potential impact on beef production in Queensland. The 5 legume species assessed were *Desmanthus* (*Desmanthus virgatus*); *Caatinga stylo* (*Stylosanthes seabrana*); *Shrubby stylo* (*Stylosanthes scabra*), *Caribbean Stylo* (*Stylosanthes hamata*) and *leucaena* (*Leucaena leucocephala*).

The spatial analysis compared research results with commercial experience of where legume species are productive and persistent, with mapping layers of landtype (soil and topography) and climate data (rainfall, frost, seasonality of rainfall). Soil and topography limitations were assessed using the Grazing Land Management (GLM) land type descriptions and mapping and rated for species suitability. Climatic limitations were defined using rainfall and frost spatial data.

The spatial analysis is still being developed at the time of writing this paper. The spatial assessment of land suitability is being developed in consultation with regional experts to ensure land suitability ratings are regionally accurate. Results from the analysis will be reviewed across Queensland to develop regionally appropriate recommendations.

## Proposed results

The output from the spatial analysis will be 3 regional maps (southern, central and northern Queensland) highlighting areas that are 'suitable' (suitable with negligible or minor limitations), 'moderately suitable' (suitable with moderate limitations), and 'unsuitable' (unsuitable with severe to extreme limitations) for the 5 legume species. The spatial analysis results will be compared to a spatial survey of where legumes are already established to identify how large the legume adoption opportunity is for the beef industry. The spatial survey will assist graziers and farm advisors to assess the suitability of key legume species to their situation.

## Discussion and conclusion

This work is part of a broader effort to quantify the pasture legume opportunity in Queensland by comparing the area of land currently established with legumes (roadside survey) to the potential area suitable for legumes (spatial analysis) and their estimated economic value (\$/ha). Combined these three datasets can help identify opportunities for growth in the Queensland beef industry.

This project will inform extension programs on where targeted education and awareness activities on establishment and best management of pasture legumes can have the greatest impact.

<sup>B</sup> Corresponding author: Vanessa.macdonald@dpi.qld.gov.au

# ***In vitro* total gas production and nutritional evaluation of tropical legumes**

S Talukder <sup>B</sup>, C Gardiner, J O'Reagain, S Nath, J Cavalier

Discipline of Veterinary Science, College of Science and Engineering, James Cook University, Qld 4811

## **Introduction**

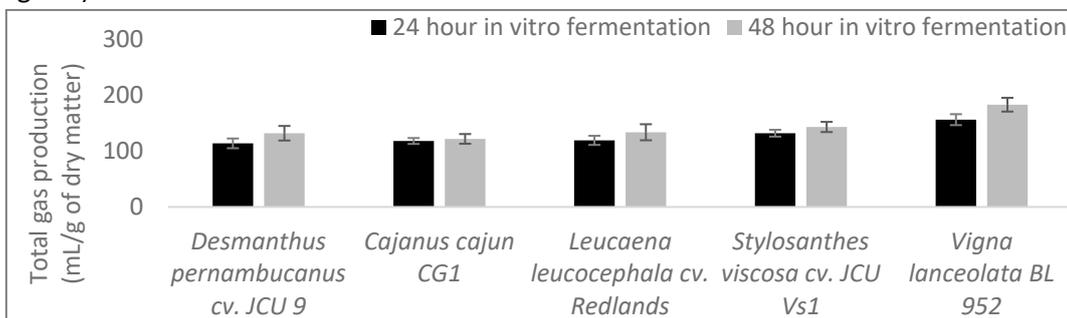
The integration of legumes into grazing systems can improve pasture resilience and enhance livestock productivity by providing palatable, digestible and high-protein forage. Some legume species also contain secondary compounds that may further improve animal performance and mitigate methane emissions (MLA, 2021). This study assessed the *in vitro* fermentability, and nutritional value of five tropical legume species for potential use in Northern Australian rangelands.

## **Methods**

An *in vitro* study was conducted using rumen fluid from steers grazing tropical grasses and legumes, to evaluate the fermentability of 5 tropical legume species: *Desmanthus pernambucanus* cv. JCU 9 (DP), *Cajanus cajan* CG1 (CC), *Leucaena leucocephala* cv. Redlands (LL), *Stylosanthes viscosa* cv. JCU Vs1 (SV) and *Vigna lanceolata* BL 952 (VL). Crude protein was determined using the Dumas combustion method and metabolizable energy (ME) was estimated. Total gas production (24–48 h) data from 4 *in vitro* runs (8 replicates/legume) were analysed using one-way ANOVA in R statistical software, with legume species as a fixed effect and *in vitro* run as a random effect.

## **Results**

At 24 h, total gas production from DP, CC and LL was similar but lower than SV and VL ( $P < 0.05$ ; Figure 1). By 48 h, CC and DP remained the lowest, VL and SV the highest, and LL showed an intermediate response. Crude protein content (% DM) was highest in DP (26.5%), followed by LL (20.8%), CC (17.2%), VL (13.3%) and SV (12.6%). The ME values were highest in LL and SV (7.3–9.7 MJ/kg DM).



**Figure 1. Total gas production (mL/g dry matter) from *in vitro* fermentation of five tropical legume species. Values represent the mean  $\pm$  SEM (error bar) of eight replicates.**

## **Discussion and conclusion**

These results suggest VL and SV exhibit higher fermentability, while DP and CC may be lower gas-producing forage options for ruminant feeding systems. High-fermentability species such as VL and SV may support rapid microbial activity and energy supply but could require careful integration to avoid excessive rumen degradability. Lower gas-producing legumes like DP and CC may provide a slower-release nitrogen source, supporting more stable rumen function, particularly in tropical grazing environments dominated by low-quality grasses. *Vigna lanceolata*, with its moderate fermentability and relatively high ME, remains a valuable option for improving diet quality and animal performance. These findings can help guide species selection in legume-grass pasture mixes to balance rumen fermentation, improve livestock productivity, and support methane mitigation strategies. Further analysis of methane output and volatile fatty acid profiles will help clarify their specific roles in low-emission grazing systems.

**Acknowledgement:** JCU Grant Support for funding; Dr Robert Kinley and Dr Breanna Roque for assistance in lab work.

<sup>B</sup> Corresponding author: saranika.talukder@jcu.edu.au

# Evaluating seed yields of *Stylosanthes seabrana* and *Stylosanthes scabra* in Southern Queensland compared to Northern Queensland

Ajay Augustin<sup>A</sup>, Ian Dunbar, Gavin Peck

Department of Primary Industries, Toowoomba 4350

## Introduction

*Stylosanthes* species (*S. seabrana* and *S. scabra*) are widely grown in northern Queensland (NQ) for pasture improvement and seed production. However, their adaptability and yield potential in southern Queensland (SQ) remain underexplored. This study compares seed crop yields of new *Stylosanthes* cultivars in SQ and NQ, focusing on the impact of planting time, growing degree days (GDD), and environmental conditions.

## Methods

Seed crop trials were conducted at the Kingaroy Research Facility (southern Queensland) during the 2023/24 growing season, with two sowings: Trial 1 in November 2023 (harvested May 2024; GDD = 1432) and Trial 2 in January 2024 (harvested June 2024; GDD = 894). Seed yields were compared with pre-commercial crops at the Walkamin Research Facility (north Queensland), which included both primary and ratoon harvests. Growing degree days (GDD) were calculated using a base temperature of 15 °C, and quadrat cuts were used to evaluate mechanical harvesting efficiency.

## Results

Seed yields showed clear planting-date effects. Early planting in southern Queensland (Trial 1, November 2023) produced good seed yields (average 471 kg/ha), comparable to northern Queensland yields (overall average 545 kg/ha—401 kg/ha and 236 kg/ha from first and ratoon harvests, respectively). Late planting in southern Queensland (Trial 2, January 2024) resulted in much lower yields (average 81 kg/ha) due to a shorter growing season and frost impact. Southern Queensland crops did not produce a ratoon harvest because of frost and the shorter season, whereas northern Queensland ratoon crops added extra yield but faced challenges including weed pressure and contamination. Mechanical harvesting in southern Queensland was 63% efficient compared with hand harvesting, with an average seed loss of 303 kg/ha. All cultivars (Dura, Ultimo, Cedo, Terra, Roxo) performed well in southern Queensland when planted early, but late planting significantly reduced yields.

## Discussion and conclusion

Seed crops in SQ rely entirely on the primary harvest, as ratoon crops are not viable due to frost and shorter growing seasons. Early planting is critical to maximise GDD and seed yields. Despite these limitations, SQ offers advantages such as reduced contamination risk and lower disease pressure compared to NQ.

The results suggest that SQ can be a viable region for *Stylosanthes* seed production, provided crops are sown early to avoid frost and maximise yields. Further optimisation of harvesting methods and timing could enhance efficiency and profitability for commercial growers.

<sup>A</sup> Corresponding author: [Ajay.Augustin@dpi.qld.gov.au](mailto:Ajay.Augustin@dpi.qld.gov.au)

# Cultivated strips fast-track legume establishment in red basalt woodland

Kendrick Cox <sup>A,C</sup>, Craig Lemin <sup>A</sup>, Steven Dayes <sup>A</sup>, Luke Bambling <sup>A</sup> and Tom Saunders<sup>B</sup>

<sup>A</sup>Department of Primary Industries, Mareeba; <sup>B</sup> (late of) Whitewater Station, Mount Surprise

## Introduction

Beef cattle production in the seasonally dry zone of north Queensland is based on uncleared native grasslands with significant feed deficits during the 6-to-8-month dry season (Rolfe *et al.*, 2016). Well adapted perennial legumes (stylo and butterfly pea) are available which can improve dry-season herbage yield and feed quality on fertile red basalt soils (Cox *et al.*, 2025). However, adoption of these legumes using ‘burn and broadcast’ methods has limited historical success, possibly due to grass competition from vigorous naturalised grasses (Indian couch and grader grass) on this fertile land type. To address the issue, DPI researchers with co-funding from Meat and Livestock Australia, have developed a replicated paddock-scale study to compare the use of cultivated strips with the burn and broadcast method to establish legume pastures as part of conducting a long-term grazing study.

## Methods

A 112 ha Indian couch and grader grass dominated site on red basalt soil near Mt Surprise (785 mm average annual rainfall, high soil-P, low soil-S) was divided into 6 paddocks with four 17 ha paddocks used for two replicates of two sowing treatments: (1) *Fire and broadcast* – burnt 7 December 2024 after first storms and broadcast seeds using a drone on 9 December, and (2) *Cultivated strips* - first cultivation (tines) of 12% total paddock area 19–20 December and regrowth sprayed 14 January followed by a second cultivation and sowing (spinner on side-by-side vehicle) and rolling (Cambridge) on 15 January. Seed testing prior to sowing indicated a potential establishment of 23 stylo seedlings/m<sup>2</sup> and 1.4 butterfly pea seedlings/m<sup>2</sup>. There was regular rainfall after both sowings. Plant populations were measured using a grid survey across the paddocks (fire and broadcast) or along rows (cultivated strips).

## Results

(1) *Fire and broadcast* – stylo establishment was successful, but populations were low overall and only achieved 7% of the theoretical short-term establishment rate (Table 1). Rapid growth of grader grass resulted in severe competition for the stylo seedlings, which grew slowly. (2) *Cultivated strips* – stylo and butterfly pea establishment was excellent with ~40 stylo plants/m<sup>2</sup> and ~3 butterfly pea plants/m<sup>2</sup> within the strips (24% and 29% survival for the stylos and butterfly pea respectively across total area). These plants grew rapidly in the absence of competition and produced seed by May, providing the opportunity to spread seeds within the paddock by grazing in the first year.

**Table 1. Mid-April plant populations (plants/m<sup>2</sup>) and success compared to seed test potential (%).**

	Fire and oversow		Cultivated strips (12% of paddock area)					
	Stylo count	Success (%)	Stylo count		Success (%)	Butterfly pea count		Success (%)
			In strips	Overall		In strips	Overall	
Mean	1.58	6.9	45.05	5.54	24.1	3.30	0.40	28.6
SEM	0.32		3.72			0.36		

## Discussion and conclusion

The use of cultivated strips appears to be a highly effective method for establishing stylos and other legumes within woodland on fertile red basalt soils through the removal of competition from companion grasses. However, the method requires some basic farming equipment and knowledge and is more expensive than the use of fire and broadcasting.

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<sup>C</sup> Corresponding author: kendrick.cox@dpi.qld.gov.au

# Silvopastoral establishment provides insight into animal production

Kerry Goodwin <sup>A,E</sup>, Nahuel Pachas <sup>B</sup>, Luke Danaher <sup>C</sup>, Steven Bray <sup>D</sup>, Angela Anderson <sup>A</sup>

<sup>A</sup> Department of Primary Industries, Gayndah 4625; <sup>B</sup> Department of Primary Industries, Nambour 4560, <sup>C</sup> Department of Primary Industries, Gympie 4570, <sup>D</sup> Department of Primary Industries, Dutton Park 4102

## Introduction

One of the silvopastoral system (SPS) establishment trials for the Steak 'n wood (Future Beef 2023) project commenced in 2021 at Brian Pastures Research Facility (BPRF), located near Gayndah in south-east Queensland. The project aims to quantify the co-benefits of SPS, relative to open pasture (OP), such as the productivity of livestock, improved animal welfare, improved on-farm biodiversity, carbon sequestration, enhanced land use and income diversification.

## Methods

Three, 5 ha paired sites containing mostly native pastures with some improved pastures are grazed on a 4-week rotation utilising commercial Droughtmaster steers (initial weight, 170kg–220kg). With the establishment of the SPS, the land area was reduced to 4 ha with electric fencing to provide protection to the growing trees. Grazing pressure for the 2 systems was determined using an initial forage budget (6 head SPS and 8 head OP). Forage budgets at the beginning and end of paddock rotations, measure changing biomass of both systems. The steers are weighed, body condition scored, and hip height measured. Additional measurements include pasture yield and quality and faecal near-infrared reflectance spectroscopy.

## Results

Table 1 demonstrates the comparison of SPS to OP for the first 2 years of the trial.

**Table 1. Two-year comparison of Silvopastoral system (SPS) vs open pasture (OP)**

Period	Open pasture		Silvopastoral system	
	2023/24	2024/25	2023/24	2024/25
Carrying capacity (ha/hd)	1.9	1.9	2.5	2.5
Average LWG (kg/hd/day)	0.66	0.64	0.62	0.66
Beef production (kg/ha/year)	128	124.4	90.6	96.4
Emission intensity (kg/CO <sub>2</sub> e/kg LW)	9.1	9.3	10.1	10.2
Cattle emission (t CO <sub>2</sub> e/ha/year)	1.07	1.15	0.91	0.98
C sequestered by trees (t CO <sub>2</sub> e/ha/year)	N/A	N/A	1.2	3.7

## Discussion and conclusion

The establishment of Silvopastoral systems had minimal effect on individual animal performances average daily gain and beef production (kg LWG/ha). A hectare difference in paddock sizes for the SPS, had a total kilogram of beef produced difference as expected with 2 less animals grazing SPS.

With exceptional growing seasons since the beginning of the project, the hardwood timber species have reached an optimal height and diameter to enable the protection of the electric fence to be removed. This provides an opportunity to better understand how cattle interact with each system. Using smart tracking collars and rumen bolus, the project is collecting data on cattle movement patterns and behaviours, rumen temperature, and drinking bouts and frequency in both SPS and OP treatments. These measurements will help to explain the average weight gains of the SPS steers, especially focusing on the warmer months. Year 4 will see the experiment on a level playing field with 5 ha paddocks and 8 animals in each treatment.

## References

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<sup>E</sup> Corresponding author: kerry.goodwin@dpi.qld.gov.au

# Vegetative propagation of putatively sterile *Leucaena* genotypes

Harshi Gamage<sup>A</sup> Chris Gardiner<sup>B</sup> Joe O'Reagain<sup>B</sup>, Chris Lambrides<sup>A,C</sup>

<sup>A</sup> University of Queensland, St Lucia 4072 <sup>B</sup> James Cook University, Townsville 4811

## Introduction

*Leucaena* (*Leucaena leucocephala* subsp. *glabrata*) is a widespread tropical forage tree legume utilised successfully across Northern Australia for beef production, with liveweight gains in the order of 0.7 kg/hd/day (Shelton et al., 2021). As well as its excellent reputation for beef production, it is also regarded as an environmental weed due to its abundant seed production, and its cultivation is now restricted in several state and local government jurisdictions (Shelton et al., 2021). To mitigate this issue a Meat and Livestock Australia funded project led by the University of Queensland (P.PSH.0884) set out to produce sterile leucaena via the application of the mutagenising agent, ethyl methanesulfonate (EMS). Several putatively sterile genotypes have been successfully produced and are under evaluation at Brisbane, with satellite regional observational plots at Townsville and Gumlu. A major research challenge for the advancement of sterile leucaena is the development of a commercially viable, high throughput method for the clonal propagation of individual sterile plants.

## Methods

Vegetative cuttings (with and without hormones), air layering, grafting and budding have been attempted and/or are ongoing. Here we briefly outline results from stem cutting and hormone treatments. At the Redland Research Facility at Cleveland a subset of stems with one node, approximately 4 mm in diameter were initially treated with hormone (ESI Root (1.6 g/L indole-3-butyric acid (IBA) + 1.6 g/L 1-naphthaleneacetic acid (NAA)) + Rootex rooting powder) across different concentrations and exposure times. Treated cuttings were planted in Jiffy plugs and placed in a mist propagation unit at 80% humidity and 26 °C. Once the optimal hormone concentration and exposure time were determined, cuttings from differing putative sterile plants were treated and their resulting propagation success evaluated.

## Results

**Table 1. Cutting and hormone treatment results for successful rooting.**

Genotype	No. of cuttings	Treatment A (control)	No of cuttings	Treatment B 800 ppm
EMS 61	10	0%	20	50%
EMS 151	10	0%	20	60%
EMS 162	20	5%	20	90%
EMS 786	25	8%	40	75%
Cultivar Redlands	10	30%	20	85%

## Discussion and conclusion

Treatment B successfully produced rooted cuttings, however, more recent experiments suggest that root hormone may not be necessary. Observations strongly demonstrate that the overriding factor determining success in propagation efforts is the maintenance of high humidity conditions. To enable future research and industry uptake of these putatively sterile *Leucaena* genotypes, relatively simple and effective mass propagation will be essential. The results presented could inform commercial clonal propagation labs in efforts toward optimising the process. Considerable investment will be required to advance this end.

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<sup>C</sup>Corresponding author: chris.lambrides@uq.edu.au

# Feed availability in mature leucaena paddocks

Polani Shadur<sup>A</sup>, Stuart Buck<sup>A,C</sup>, Kylie Hopkins<sup>A</sup>, Kerry Goodwin<sup>B</sup>, Bradley Taylor<sup>B</sup>, Melissa Dayman<sup>B</sup>

Department of Primary Industries, <sup>A</sup>Rockhampton 4702, <sup>B</sup>Gayndah, 4625

## Introduction

Leucaena (*Leucaena leucocephala*) is a valuable forage legume that increases productivity and profitability of cattle enterprises. However, on-going poor management can result in tall growth where much of the edible biomass occurs above cattle browse height. This can lead to the undesired establishment of dense volunteer leucaena plants and suppressed inter-row pastures which further reduces grazing value. The leucaena paddocks established > 45 years at Brian Pastures Research Facility (near Gayndah, south-east Queensland) illustrate these challenges and provided a basis for assessing the distribution dynamics of accessible versus inaccessible leucaena biomass for grazing cattle.

## Methods

In May 2025, 16 representative sites across four paddocks were selected for leucaena and pasture biomass measurements. At each site, a 3 m section of leucaena row was marked. Edible leucaena biomass (leaf and stem to 5 mm diameter) was hand-stripped into three components: (i) biomass < 2 m high (within browse height), (ii) biomass > 2 m high (above browse height), and (iii) biomass on volunteer plants in inter-row. Total grass pasture biomass was cut (using 0.25 m<sup>2</sup> quadrats) from 4 representative areas per site. Samples were oven-dried at 75 °C and converted to dry matter (kg/ha) using row dimensions and quadrat area.

## Results

Total edible leucaena dry matter averaged 1,286 kg/ha across the sites. 123 kg/ha of edible dry matter was under 2 m (10%), 767 kg/ha was above 2 m (60%) and 396 kg/ha (30%) was contributed by volunteer plants. The companion grass dry matter averaged 352 kg/ha across all sites.

## Discussion and conclusion

Although total dry matter biomass was typical for leucaena systems (Bowen et al., 2016), in these paddocks the majority (60%) was inaccessible to cattle and 30% was growing in the inter rows, competing with grass. Although leucaena provides high-quality leaf, the balance between grass and leucaena is integral to maintaining high cattle liveweight gain and stocking rates, and long grazing periods (Bowen et al., 2016).

The feed distribution dynamics in overgrown leucaena systems reflect the broader challenges in managing mature leucaena stands. Research and commercial experience suggests adaptive grazing practices are important to sustain grazing productivity (Buck et al., 2019). While mechanical renovation is recommended when forage grows beyond browse height, economic analysis is also needed to determine whether the benefits of renovation justify the costs.

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<sup>C</sup>Corresponding author: stuart.buck@dpi.qld.gov.au

# Urea boosts biomass but reduces litter cover in gully remediation

Kate McCullough<sup>B</sup>, Simon Hunt

Department of Primary Industries, Charters Towers 4820

## Introduction

Gully erosion is a significant challenge for the Northern Australian beef industry, contributing to land degradation, reduced pasture productivity, and sediment runoff into waterways. Addressing this issue is critical to ensuring the long-term sustainability of grazing enterprises. This paper presents findings from a gully remediation project in North Queensland that investigated the relationship between litter cover (%) and pasture yield (kg DM/ha) under different rehabilitation strategies. Findings were linked to C:N balance, highlighting the importance of this ratio in gully remediation.

## Methods

After initial earthworks to reprofile the eroded surface, the site was sectioned into 9 different treatment groups to test different amendments. A paired treatment incorporated organic matter and gypsum into the upper 300 mm of the soil, deep ripping to 500 mm, bagasse laid 40 mm deep over the surface, and a pasture seed mix spread at 40 kg/ha. One of the pairs also received an additional 2.7 t/ha of broadcast urea (N). Pasture measurements, including BOTANAL yields (kg DM/ha), bare ground % (exposed soil), and litter cover % (including bagasse) were completed after the first wet season in April 2025. A 1 m<sup>2</sup> quadrat was used to take 30 assessments per section.

## Results

The nitrogen treatment demonstrated higher yields but significantly lower litter cover compared to the no-nitrogen treatment ( $P < 0.05$ ). The N treatment recorded +641 kg DM/ha compared to the no nitrogen treatment, but 48% less litter cover. Despite less litter cover, bare ground % was less in the N treatment. Living biomass colonised this bare ground and improved ground cover stability.

**Table 1. Effect of urea application on litter cover, bare ground and biomass at Spyglass Research Station, April 2025.**

	Litter (%)	Biomass (kg DM/ha)	Bare (%)
Nitrogen	24	1,126	9
No Nitrogen	72	485	17

## Discussion and conclusion

The results highlight nitrogen as a primary limiting factor for plant growth in Northern Australia during wet years, consistent with findings by Mott et al., (1985). N application has been shown to balance the C:N ratio and hence accelerate litter decomposition through microbial activity (Knorr 2005; Griffin 1972). Hence, the urea application at the site likely boosted microbial activity early in the season but also balanced the C:N ratio, “pre-feeding” the microbes and making more N available for plants later in the growing season. This effect manifested in the gully as increased yields coupled with increased litter decomposition due to microbial activity. An unbalanced C:N ratio will cause N to be utilised in microbial bodies and unavailable for plant uptake (Murphy 2015).

In conclusion, C:N ratio is a vital consideration when rehabilitating eroded gullies in North Queensland. Achieving balance boosts pasture productivity and ground cover stability, supporting long term sustainability for the beef industry.

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<sup>B</sup> Corresponding Author: [Kate.mccullough@dpi.qld.gov.au](mailto:Kate.mccullough@dpi.qld.gov.au)

# New stylo varieties for frosty locations

Gavin Peck<sup>AB</sup>, Louise Walker<sup>A</sup>, Ian Dunbar<sup>A</sup>, Ajay Augustin<sup>A</sup>, Ted Callanan<sup>A</sup>, Vanessa Macdonald<sup>A</sup>, Kendrick Cox<sup>C</sup>

Department of Primary Industries, <sup>A</sup> Toowoomba 4350; <sup>C</sup> DPI Mareeba

## Introduction

Pasture legumes have been identified as the best long-term option to increase productivity and profitability of grass pastures for large areas of Australia. However, finding legume varieties that are suited to the frost prone sub-tropics has been challenging due to low and unreliable winter rainfall resulting in poor persistence of temperate legumes (e.g. subterranean clover); while frosty winters and less rainfall during the summer growing season than in more northerly districts have resulted in poor persistence of tropical legumes (e.g. shrubby stylo *cv. Seca*). Some legumes have persisted on clay soils (e.g. medic and desmanthus); however, there are currently no commercially available legume varieties that are widely persistent on light soils (loams and sands) in southern Queensland. This paper describes the evaluation and planned commercialisation of five new stylo varieties that aim to fill the gap in available legume varieties for this important climate zone.

## Methods

A summary of the evaluation methodology is provided in this paper, and a full description is available in Peck et al., (2022). Multiple accessions of stylo from multiple species persisted and spread at old pasture evaluation trial sites at more southerly latitudes, with greater frost frequency, than considered suitable for commercial varieties. Forty legume accessions were described and seed re-collected from 8 sites (36 accessions of stylo, 3 desmanthus and 1 *Neptunia* sp.); however, the seed crop of one of the stylo accessions was severely damaged by disease, resulting in 39 accessions for sowing in new evaluation trials.

The 39 collected accessions, 3 experimental accessions shortlisted from other projects and 10 commercial legume varieties were sown in 2016 at six evaluation trial sites across southern Queensland. One of these trial sites failed to establish with adequate plant density due to soil crusting. The remaining five trial sites were assessed over four growing seasons.

## Results

Five stylo accessions were selected for release as new legume varieties for light textured soils in frosty locations in the sub-tropics. These five new stylo varieties produced 40 to 70% higher average yields than the best performing, commercially available legume variety (*cv. Unica*, a Caatinga stylo) across five trial sites in the third and fourth growing seasons after sowing. These measurements were conducted during severe drought years that were in the driest 10% of years for the districts where the trials were located.

## Discussion and conclusion

Five new stylo varieties that were identified and re-collected from old trial sites have the potential to increase the geographic range suitable for sowing legumes in southern Queensland where previously there were no suitable legume varieties. The new varieties had significant yield and persistence advantages over existing legume varieties where tested; therefore, they also have the potential to improve productivity for large areas where existing varieties are suited. DPI and MLA have partnered with a seed company to commercialise these new varieties. Research and extension activities have commenced to support the commercialisation and adoption of these promising new stylo varieties.

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<sup>B</sup> Corresponding author: Gavin.Peck@dpi.qld.gov.au

# Testing pasture establishment techniques in the Desert Uplands

Dana Walkington<sup>A,C</sup>, Stuart Buck<sup>B</sup>, Kylie Hopkins<sup>B</sup>, Polani Shadur<sup>B</sup>

<sup>A</sup> Department of Primary Industries, Emerald 4720; <sup>B</sup> Department of Primary Industries, Rockhampton 4700

## Introduction

The Desert Uplands bioregion comprises 75,000 km<sup>2</sup> of grazing land in north Queensland. Sowing pasture species for pasture improvement is not common practice due to low rainfall and low soil fertility however the desire to increase productivity has producers considering a new approach. A pasture establishment demonstration has been initiated on *Stratford* located approximately 50 km south of Jericho. The aim is to determine the outcomes of broadcasting legume (and grass) seed into various seedbed preparation conditions in red sandy-loam soil typical of the Desert Uplands region.

## Methods and results

Treatments implemented were considered achievable in this landscape with machinery commonly available. Five soil renovation methods with and without fertiliser were replicated twice and randomly allocated to plots (Fig. 1). Soil disturbance with a Yeomans ripper was undertaken a few days prior to planting, and Roundup herbicide (4L/ha) was applied at planting. The site was planted on the 26<sup>th</sup> of February 2025. A mix of stylo legumes (15% caatinga stylo (Primar and Unica) and 85% shrubby stylo (Seca and Siran)) were broadcasted at 3.9kg/ha, and coated Buffel grass (Gayndah) seed was included (31.2kg/ha) with the legume mix in one treatment. A soil test was taken (0-10cm layer only) prior to planting which showed low nitrogen, phosphorus, sulfur and calcium levels thus 239kg/ha of single super-phosphate was broadcasted at planting.

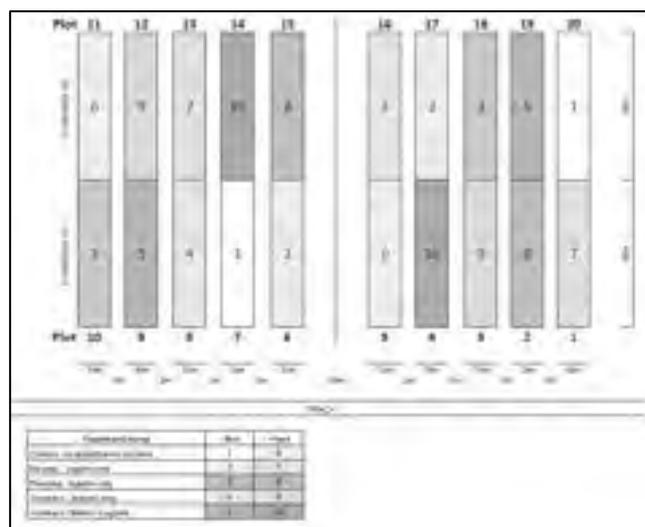


Fig. 7. Stratford demonstration design

Renovation method	Plants/m <sup>2</sup>	
Nil, no legume	0.2	c
No prep + legume	5.4	bc
Roundup + legume	26.2	a
Yeomans + legume	19.1	ab
Yeomans + legume + buffel	33.9	a
P value	0.1	
s.e.	5.3	
s.e.d	7.5	
l.s.d	17.2	

\* Values with different letters are significantly different.

Table 3. Legume population established (averaged across fertiliser treatments)

## Discussion and conclusion

Despite the dry planting conditions, 160 mm of soaking rain in late March produced good plant establishment in all sown treatments. Assessments on the 19<sup>th</sup> June 2025 showed significantly higher legume population where the pasture and/or soil was disturbed (Table 1). However, no significant difference was measured between applying herbicide or ripping with yeomans plough prior to planting. The number of plants established in the *No-prep + legume* treatment was significantly lower than the other disturbed treatments, but establishment may be sufficient to generate further thickening if these plants survive to produce more seed. No impact of fertiliser on plant establishment or growth has been generated yet. Initial observations from this demonstration holds promise for the potential to increase productivity through establishing sown pastures in the Desert Uplands bioregion.

<sup>C</sup> Corresponding author: dana.walkington@dpi.qld.gov.au

# Soil carbon sequestration under tropical perennial legume *Desmanthus* in Northern Australian grasslands

David Rowlings<sup>A</sup>, Elaine Mitchell, Mark Bonner, Chris Gardner (retired), Zahra Mirsafi, Naoya Takeda, Sandra McEwan, Peter Grace

Sustainable Agroecosystems, Queensland University of Technology, Brisbane, QLD

## Introduction

Extensive, unfertilised Northern Australian pastures are commonly nitrogen (N)-limited, constraining productivity and soil organic carbon (SOC) sequestration. Tropical legumes—particularly *Desmanthus* on clay soils—may alleviate N limitation and increase SOC, yet evidence on magnitude, depth distribution and mechanisms remains limited. This study asks whether *Desmanthus*-improved pastures store more SOC (and total N) than comparable unimproved pastures and explores likely drivers and implications for greenhouse-gas (GHG) balances.

## Methods

A space-for-time paired-site design was used across 12 site pairs spanning Northern Australia. Sites were matched on soil type, land-use history and other attributes; *Desmanthus* density  $\geq 0.2$  plants  $m^{-2}$  was required. Intact soil cores to 1 m were sectioned by depth and analysed for SOC and total N; results were also standardised by equivalent soil mass (ESM). Treatment effects were estimated with weighted Box-Cox t-distributed generalised mixed-effects models; an exponential curve (Bayesian non-linear regression) related SOC change to years since establishment. A companion plot-scale trial quantified root biomass profiles. A simple per-hectare GHG balance contextualised SOC gains relative to herd emissions at typical stocking rates.

## Results

Ten of 12 pairs showed higher SOC under *Desmanthus*. Models estimated  $+7.5$  t C  $ha^{-1}$  to 1 m ( $P < 0.001$ ), equivalent to  $0.47$  t C  $ha^{-1} yr^{-1}$  over the mean 16-year age. Differences were negligible at 0–10 cm but significant at deeper intervals. An exponential fit indicated most gains accrue in the first decade. Total N was  $+0.2$  t N  $ha^{-1}$  ( $P < 0.001$ ) to 1 m. Root density was consistently greater under *Desmanthus* across the profile. A simple GHG balance suggested paddock-scale SOC gains could offset a substantial share of herd emissions in the first decade (~25-50% of herd emissions).

## Discussion and conclusion

*Desmanthus*-improved pastures stored significantly more SOC and N than matched controls, with gains concentrated below 10 cm and accumulating rapidly in early years. Likely mechanisms include higher C and N inputs (N-fixation, enhanced companion-grass growth), deeper rooting and increased microbial processing/necromass formation that favours mineral association. Adoption remains constrained by establishment and persistence challenges, costs and site limitations; net-GHG outcomes should also consider potential  $N_2O$  emissions during N cycling. Nonetheless, targeted agronomy and realistic deployment could deliver meaningful SOC gains and productivity benefits in northern grazing systems.

<sup>A</sup> Corresponding author: David Rowlings: d.rowlings@qut.edu.au

# Steak n Wood project: Silvopastoral systems research in Queensland and Northern New South Wales

Nahuel Pachas<sup>A,B,E</sup>, Luke Danaher<sup>A</sup>, Steven Bray<sup>A</sup>, David Lee<sup>B</sup>, Anthony Burridge<sup>A</sup>, Kerry Goodwin<sup>A</sup>, Tyron Venn<sup>C</sup>, Tracey Menzies<sup>A</sup>, Bill Schulke<sup>D</sup>, Angela Anderson<sup>A</sup>, Tien Chinh Nguyen<sup>B</sup>

<sup>A</sup> Department of Primary Industries, Nambour, Qld 4560; <sup>B</sup> University of Sunshine Coast, Sippy Downs, QLD 4556, <sup>C</sup> The University of Queensland, St Lucia Qld 4072, <sup>D</sup> Private Forest Service Queensland, Gympie, Qld 4560

## Introduction

Silvopastoral systems (SPS) are an innovative land management strategy that deliberately integrate livestock and trees to produce both beef and timber, while delivering co-benefits such as carbon sequestration, income diversification, biodiversity enhancement, soil erosion reduction, and improved animal welfare (Jose & Dollinger, 2019). The Steak n Wood project aims to validate and quantify the productivity impacts of integrating timber trees with cattle and the co-benefits associated with silvopastoral systems in Queensland and northern New South Wales.

## Methods

Long-term silvopastoral sites were established in private native forest (PNF) and planted hardwood systems from Rockhampton to northern NSW in areas with >700 mm annual rainfall. Tree–pasture interactions, biodiversity, and animal productivity have been monitored at these sites in collaboration with beef producers since 2022. Discounted cash flow financial evaluation of these systems accounted for declining livestock production as trees mature, and potential carbon market opportunities.

## Results

Thirteen sites have been successfully established since 2022 with ongoing monitoring of tree growth, soil carbon, and pasture productivity covering over 900 hectares (Table 1). In total, 122 permanent plots were established to monitor tree and pasture growth, and 240 exclusion cages have been installed to measure tree-pasture interactions. Intensive soil carbon sampling included 618 core samples across 41 plots. Animal productivity has been recorded at Brian Pastures Research Facility (BPRF) since 2022. The carbon storage, and biodiversity of invertebrates and birds in hardwood silvopastoral systems are being evaluated and compared to adjacent open pastures and remnant forests.

**Table 1: Summary of the Steak n Wood experimental sites in PNF and with planted hardwood (HWD) timber species.**

Sites	1	2	3	4	5	6	7	8	9	10	11	12	13
SPS PNF					●	●	●	●				●	●
SPS HWD	●	●	●	●					●	●	●		
Treatments	4	3	2	3	3	4	3	2	2	6	3	4	3
P. plots*	23	6	2	6	12	8	3	2	4	18	14	12	12
E. cages**	54	18	NA	NA	36	24	15	6	12	36	21	12	6
Area (ha)	28	30	5	4	792	8	5	2	10	4	6	4	4

\*Total permanent plots; \*\*Exclusion cages

## Discussion and conclusion

The alley planting configuration appears to be a feasible option for beef producers looking to integrate trees into grazing systems without substantially impacting livestock productivity. Managing SPS in PNF also seems to be a key opportunity for beef producers to enhance income diversification.

## References

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<sup>E</sup> Corresponding author: nahuel.pachas@dpi.qld.gov.au

# On-property research and strong relationships result in practice change that increases land condition and carrying capacity in Western Queensland

Dana Walkington<sup>B</sup>, Paul Jones (decd.)

Department of Primary Industries, Emerald QLD 4720 Australia

## Introduction

Land condition has declined across large areas of Northern Australia due to inappropriate grazing practices. Despite extensive extension efforts, adoption of improved practices such as wet season spelling and matching stocking rates to available forage has not been universal. This case study demonstrates how on-property research combined with extension has driven practice change on a property near Jericho in Western Queensland.

## Methods

The 'Developing long-term carrying capacity models for the Desert Uplands (DU)' project ran from 2003 to 2005 and aimed to reduce land condition decline by establishing the long-term carrying capacities (LTCC) for DU land types (Jones et al. 2006) based on modelled estimates and grazer experiences. Nine properties were established as calibration sites to monitor land condition, stocking rates and pasture production. Host landholders were also facilitated as a peer-peer learning group, the project leader (PJ) maintained contact with the group for the following 19 years helping members implement the project's recommendations. In 2023, the original monitoring sites on the case study property near Jericho were revisited to assess land condition and interview the landholder to document changes in management practice over the previous 20 years.

## Results

Results of the interview showed that the landholder had implemented a range of improved practices including rotational grazing, wet season spelling, fencing to land type, and stocking around LTCC. The property had also doubled the number of paddocks and increased the number of watering points. As a result, carrying capacity had increased from 700 adult equivalents (AEs) in 2004 to 1,000 AEs in 2023. Land condition had been maintained over 20 years and had improved at some monitoring sites from C (poor) to B and from B to A condition, as shown by an increase in the presence of key perennial pasture species such as desert blue grass (*Bothriochloa ewartiana*). This improvement occurred despite the overall increase in property stocking rates.

## Discussion and conclusion

Participation in the original LTCC project gave the landholder the knowledge and resources to implement new practices, positively impacting both land condition and productivity. Ongoing contact with the project leader over the last 20 years – and their successor (DW) – helped maintain these changes. These results demonstrate the long-term impact of on-farm research and extension and highlight the importance of strong relationships between agencies and producers.

## Acknowledgements

This paper is dedicated to our late colleague Paul Jones who initiated and maintained the original work. We thank the property owner and the Desert Uplands Build-up and Development Strategy Committee for their ongoing support and commitment.

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<sup>B</sup>Corresponding author. Email: dana.walkington@dpi.qld.gov.au

# Managing myostatin mutations (double muscling) in Northern Australian tropically adapted beef breeds

Kirsty Moore<sup>A,C</sup>, David Johnston<sup>A</sup>, Tim Grant<sup>B</sup>

<sup>A</sup>AGBU, a joint venture of NSW Department of Primary Industries and University of New England, Armidale, 2351, <sup>B</sup>Queensland Department of Primary Industries, Toowoomba, Qld 4350, Australia,

## Introduction

The myostatin gene influences muscle production in beef and other species. Many mutation variants have been identified, resulting in the inactivation of the myostatin gene and the appearance of 'double-muscled' cattle. Limited studies have considered myostatin mutations in tropically adapted beef breeds. This study aimed to estimate the allele frequencies of myostatin mutations in Australian Brahman, Droughtmaster and Santa Gertrudis breeds.

## Methods

Myostatin genotypes from Neogen's GGP\_TropBeef chip were obtained from animals born between 2015 and 2023 under the Repronomics project, including Brahman (n = 2,554), Droughtmaster (n = 2,188), and Santa Gertrudis (n = 904) animals. Nine myostatin variants were considered; C313Y, D182N, E226X, E291X, F94L, NT419, NT821, Q204X and S105C. DNA samples were collected on all project animals born, including calves that died at or shortly after birth. Project sires were selected to represent the wider breed population, especially if the sire was influential, and there were 104, 83, and 41 sires represented in the dataset, respectively for Brahman, Droughtmaster and Santa Gertrudis. Sires were mated to cows of the same breed. Female calves were retained in the cow herd and were the dams of future generations. Allele frequencies were calculated based on the number of animals with 0, 1 or 2 copies of the myostatin alleles.

## Results

No myostatin variants were shown to segregate in Brahman. NT821 and F94L myostatin variants were present in the Droughtmaster and Santa Gertrudis animals. Of the Droughtmaster and Santa Gertrudis animals, 17.4% and 26% carried at least one myostatin allele from either variant. The estimated gene frequency of the NT821 mutation was 0.08 for Droughtmaster, with 84.6, 15.1 and 0.2% animals having 0, 1 and 2 myostatin alleles, respectively. For Santa Gertrudis, the estimated gene frequency of the NT821 mutation was 0.12, with 77.1, 22.0 and 0.9% animals having 0, 1 and 2 myostatin alleles, respectively. The F94L mutation had a lower gene frequency for both breeds, 0.01 and 0.02, respectively, for Droughtmaster and Santa Gertrudis. No 2 copy animals were observed, and 2.2 and 3.5% of Droughtmaster and Santa Gertrudis animals had 1 copy of the F94L mutation.

## Discussion and conclusion

Myostatin mutations have been associated with increased carcase yields, reduced fat, increased calving difficulty, delayed puberty, and reduced female fertility. However, the size of the myostatin effect is different for each mutation variant. Unlike recessive genes (e.g., polled/horn), where the phenotype is only impacted when there are two copies, having one copy of a myostatin mutation impacts the animal's phenotype, with an even greater effect from having two copies. DNA testing for myostatin is an essential management tool, and knowledge of the myostatin status of individual animals can inform mating decisions to minimise the impact of myostatin on the herd.

<sup>C</sup>Corresponding author: kmoore7@une.edu.au

# Solving the discordance between poll genotypes and phenotypes in Northern beef cattle

Elizabeth Ross<sup>D</sup>, Tony Cavallaro, Loan Nguyen

QAAFI, The University of Queensland, St Lucia 4072

## Introduction

Genetic tests for poll alleles are currently available through standard genomic testing methods. Several producers have anecdotally reported discordance between the phenotype of the animals and the reported genetic poll status. Four poll alleles have been previously identified in cattle (Randhawa *et al.*, 2020), but only two are currently included on the standard genotyping arrays.

## Methods

Producer records for poll genotype status were collated from Consolidated Pastoral Company (CPC; Queensland, Australia). In addition, genomic samples from a subset of these animals were obtained. DNA was extracted from the samples according to the protocol used in Lamb *et al.*, (2020). DNA from seven animals was sequenced on an Oxford Nanopore Technologies PromethION using the Rapid sequencing protocol. Integrative Genomics Viewer was used to manually identify structural variants.

## Results

A total of 65 samples were provided for analysis, all with array-based poll genotype calls of horned (HH). Of these, just over half were recorded as phenotypically either polled or scurred (Table 1). Four of the phenotypically polled animals and three of the phenotypically horned animals were selected for analysis. All four of the phenotypically polled animals displayed a structural variant consistent with one of the poll alleles reported in the literature which is not included on the current genotyping arrays. All three of the horned animals displayed no structural variants consistent with any of the reported poll alleles.

**Table 1. Number of commercial cattle samples provided from CPC Queensland Australia.**

Phenotype	Genotype from array	Count
Horn	HH	15
Scur	HH	19
Poll	HH	31

## Discussion and conclusion

These results are the first confirmation of a poll allele in the Australian northern beef cattle sector that is not present on the commercial SNP arrays. These findings suggest that the discordance observed by Randhawa *et al* (2020), where 5.2% of phenotypically polled or scurred animals returned a horn genotype, is not due to miscalling of the Celtic or Friesian alleles, but rather the presence of different poll alleles in the Australian population. These findings have the potential to resolve some of the discordance between the commercial poll DNA testing results, and the observed phenotypes on farm.

## References

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<sup>D</sup> Corresponding author: e.ross@uq.edu.au

# Water-based vs. traditional supplementation of cattle: A case study

Elieder Prates Romanzini <sup>A,B</sup>, Sarah Mcilveen <sup>A</sup>, Mark Peart <sup>A,C</sup>

<sup>A</sup> DIT AgTech, Toowoomba Qld 4350

## Introduction

In extensive grazing systems, liveweight response to supplementation is linked to increased digestible energy intake, partly through stimulated forage consumption (McLennan *et al.*, 1989). This case study evaluated the efficacy of two supplementation strategies—traditional lick blocks and a uDOSE™ water-based supplementation system—in growing cattle.

## Methods

The case study was conducted on a 5,721 ha commercial cattle station from July 2024 to April 2025 (271 d), with 750 heifers (mean weight = 174 kg) allocated to a lick block paddock (3,495 ha) or a water-supplementation paddock (2,226 ha) at an initial stocking rate of 0.07 AE/ha in each paddock. Heifers had *ad libitum* access to native pastures (Mitchell grass, Buffel grass and Flinders grass) and their respective diet supplements. The diet supplements used were urea-based. The lick-block supplement contained 40% urea and was consistent throughout the 271-day period; it also provided 2% phosphorus, 2% molasses, and additional trace elements. The water-based supplements contained 43% and 40% urea, respectively, and were replaced in January 2025 to increase the phosphorus concentration (from 4.3% to 5.2%). Unlike the lick-block supplement, the water-based supplements supplied only nitrogen, phosphorus, and sulphur. Forage availability was estimated using CiboLabs – Pasture Key (2025) readings obtained monthly throughout the study. Statistical analyses were performed in R (v4.3.2). Bioeconomic evaluation followed protocols from Cumbe *et al.*, (2021).

## Results

Mean forage availability was 858 kg DM/ha in the lick block paddock and 983 kg DM/ha in the water-supplementation paddock ( $P = 0.14$ ). Cattle maintained liveweight (LW) during the dry season and gained LW in the wet season, reaching 295 kg. Average daily gain (ADG) was higher with water-based supplementation (0.466 vs. 0.413 kg/d,  $P < 0.0001$ ). Supplement intake differed significantly ( $P < 0.0001$ ), with lick block cattle consuming more urea equivalent, while water-supplemented cattle consumed more phosphorus (P). Cattle consuming water-based supplement generated \$33.43/head higher gross revenue than the lick block group (Table 1).

**Table 1.** Comparison of the two diet supplementation methods.

Variable	Lick Block	Water-Based Supplement
Average Daily Gain (ADG) (kg/d)	0.413 <sup>b</sup>	0.466 <sup>a</sup>
Urea Equivalent consumption (g/head/d)	25.90 <sup>a</sup>	17.82 <sup>b</sup>
Phosphorus consumption (g/head/d)	1.07 <sup>b</sup>	1.20 <sup>a</sup>
Gross Revenue (\$/head)	754.78	788.21

<sup>a,b</sup> Means with different superscript letters differed by Tukey Test at 5% significance.

## Discussion and conclusion

The uDOSE™ system enabled safe delivery urea-based supplements when compared to *ad libitum* consumption from lick block supplementation method. The controlled delivery via drinking water enabled higher P consumption during the wet season. It resulted in a higher ADG than lick blocks, despite a lower intake of urea. The water-based supplementation was more cost effective than lick blocks and represents a practical alternative for extensive cattle production in Northern Australia.

## References

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<sup>B</sup> Corresponding author: [eli@ditagtech.com.au](mailto:eli@ditagtech.com.au); <sup>C</sup> Presenter author: [mark@ditagtech.com.au](mailto:mark@ditagtech.com.au)

# Easy P – evaluation of a phosphorus supplementation strategy that is easy to implement in areas that are difficult to access during the wet season.

Tim Schatz<sup>A,C</sup>, Mark Hearnden<sup>A</sup>, Zach Weir<sup>B</sup>

<sup>A</sup> NT DAF, Berrimah Farm, Darwin NT 0801; <sup>B</sup> NT DAF, Victoria River Research Station, NT 0851

## Introduction

The “Easy P” strategy was designed to overcome the difficulties associated with conducting supplementation programs during the wet season in Northern Australia. It involves including phosphorus (P) in dry season supplement and supplying enough P supplement before the wet season to last its duration. This study compares the Easy P method to traditional wet season supplementation.

## Methods

This study was conducted at Victoria River Research Station, in P-deficient paddocks (average Colwell P soil test results: 2.5 and 3.1 mg P/kg). In May 2020, 181 18-month-old Brahman heifers were stratified based on liveweight and randomly allocated to either an Easy P (EP) or traditional supplementation (TS) treatment, to give two groups of similar number (EP = 90, TS = 91) and average weight (EP = 270.6 kg, TS = 266.3 kg). The treatments were managed in the same way except for the mineral loose lick supplement given to the groups. The dry season supplements were either EP; comprised of 25% urea, 25% monocalcium phosphate (MCP), 10% gran am., 40% salt, or TS; 25% urea, 10% gran am., 65% salt. The wet season supplement composition was the same for both treatments (42.5% MCP, 7.5% gran am., 50% salt) but the EP treatment was given two one- tonne bulk bags in December prior to the wet season while supplement was delivered regularly to the TS treatment throughout the wet season. The P source was a high quality MCP (Total P = 22.7%, TAC Value = 85%). Heifers were first mated at two years old and mating was from late December to early May. The animals were mustered twice a year to record data and wean calves.

## Results

EP heifers grew 10 kg heavier over the first dry season (Table 1). Calf loss in TS was 11 percentage units higher in 2024. Mean calf weaning weight was 20 kg heavier from EP in 2023. Weaning rate was 17 percentage units higher from EP cows in 2023. Annual liveweight production was higher in EP in 2022 (+20 kg) and 2024 (+76 kg). The performance of the groups was similar for other measures.

**Table 1. Production measures of the Easy P and traditional supplementation treatments.**

Measure	Easy P	Traditional	Significance
Maiden heifer pre-mating mean liveweight (kg)	286	276	<0.05
Maiden heifer pregnancy rate (%) in May 2021	95	94	NS
Mean first lactation heifer liveweight (kg) in May 2022	379	365	<0.05
First lactation heifer pregnancy rate (%) in May 2022	80	68	NS
Weaning rate 2022	82	87	NS
Weaning rate 2023	72	55	<0.05
Weaning rate 2024	79	71	NS

## Discussion and conclusion

The performance of EP was as good or better than TS in all measures assessed. These results suggest that the Easy P strategy will be an effective supplementation strategy for areas in Northern Australia that are difficult to access during the wet season.

<sup>C</sup>Corresponding author: tim.schatz@nt.gov.au

# Breedcow Lite – streamlined for dynamic use by graziers and advisors

Harry Milbank <sup>A,C</sup> & Janna Sim <sup>B</sup>

<sup>A</sup> Department of Primary Industries (DPI), Bundaberg QLD 4670; <sup>B</sup> DPI, Charters Towers QLD 4820

## Introduction

The profitability of Australian primary producers is critical to regional economies. But what options do graziers have to improve their returns, and that is within their control? Strategic decision-making requires managers to gather information, evaluate alternative options and take actions that improve business performance. However, graziers and advisors have limited time and imperfect information, so tools that streamline these processes are fundamentally valuable.

## Methods

Breedcow+ was designed to help graziers better understand their herd and cost structures and weigh up the costs and benefits from employing different management options. Despite the tool's capabilities, user feedback identified that it is complex to navigate and time consuming to use. To address these challenges, grazing economists consulted with graziers, beef extension officers and coding programmers on ways to improve the functionality of Breedcow+ to service a wider range of users. This information was used to guide the development of a streamlined version of the tool, which was reviewed with further feedback incorporated after extensive testing and model validation.

## Results

A simple online interface was developed requiring one input for each Breedcow+ section (Fig 1. weight gain, conception, mortality, prices). Each input is informed by historical data and advisor experience to construct a full Breedcow+ file. Consequently, the number of user inputs decreased from around 590 to just 13, enabling new users with minimal training to use the tool. Some assumptions are static (e.g. 3% bull to cow ratio), while others dynamically adjust based on input values (e.g. higher growth rates result in earlier maturity). Herd information and financial metrics are displayed with users able to compare up to 5 scenarios. Users can also refine all inputs in the full Breedcow file allowing for detailed customisation to suit individual circumstances.



Variable	Scenario 1	Medium	Difference
Average liveweight gain (steers) (kg/ha/yr)	130	145	15
<b>Calvers</b>			
Breeder conception % (preg test only)	75%	75%	
Preg test empty sales (%)	75%	100%	25%
<b>Drainers</b>			
Calf loss % (preg test to weaning)	15%	15%	
Breeder mortality %	5%	5.0%	

Figure. 1. Partial screenshot of the Breedcow Lite herd modelling tool.

## Discussion and conclusion

Breedcow Lite automates the development of a Breedcow+ file and eliminates the need for more complex tasks, such as balancing the herd and allocating surplus heifers. Consequently, the tool is less complex and more user friendly for time poor graziers and advisors. Moreover, users can quickly proceed to evaluating their options to improve business performance. Breedcow Lite supports identifying the most profitable turnoff ages, conducting breakeven analyses, and exploring supplementation and other management strategies. It delivers the same strategic insights as its powerful parent but with lower inputs. Breedcow Lite is currently being extended to industry.

<sup>C</sup> Corresponding author: [harry.milbank@dpi.qld.gov.au](mailto:harry.milbank@dpi.qld.gov.au)

# Pre-calving nutrition improves reproductive efficiency in northern beef herds

Luis Prada e Silva <sup>A</sup>, Gemma Somerset, Sarah Gwynne, Kieren McCosker, Karen Eyre

Queensland Alliance for Agriculture and Food Innovation, The University of Queensland, Gatton, QLD 4343

## Introduction

Reproductive efficiency is a key driver of productivity in Northern Australian beef systems, where breeders must conceive while rearing a calf. Nutrition during late gestation may influence the ability of cows to reconceive. The Calf Alive project evaluated the effect of pre-calving supplementation on reproductive outcomes in commercial herds in Queensland and the Northern Territory

## Methods

Pregnant cows (n = 6,570) were enrolled from 8 properties in 2022, 12 in 2023, and 10 in 2024, yielding 30 experimental units. Cows were stratified by liveweight, calving date, and lactation status, and then randomly allocated to control (routine management) or supplementation groups. Supplemented cows received a protein- and energy-rich ration providing 300–400 g crude protein/day for ~6 weeks before calving. Reconception rate was the proportion of lactating cows pregnant again at weaning. P4M is the percentage of lactating cows that became pregnant within four months after calving. Outcomes were analysed with generalised linear mixed models, with property and treatment × property as random effects. Within each property, cows were stratified into low, medium, and high weight classes based on their pre-supplementation liveweight distribution (mean ± 0.43 × SD)

## Results

Supplemented cows had higher reconception rates than controls (77.7% vs 68.1%,  $P = 0.019$ ) and tended to have more cows pregnant within four months (64.5% vs 53.8%,  $P = 0.065$ ). Breeders had higher reconception than heifers and yearlings (85.7%, 77.4%, and 49.5% respectively;  $P = 0.027$ ), but age did not affect P4M. Cows in higher weight classes were more likely to reconceive ( $P = 0.024$ ), whereas weight had no effect on P4M.

**Table 1. Percentage of cows that reconceived and were pregnant again within 4 months (P4M).**

Factor	Category	Reconception (±SE)	P-value	P4M (±SE)	P-value
Treatment	Control	68.1 ± 8.9	0.02	53.8 ± 11.8	0.06
	Treatment	77.7 ± 7.1		64.5 ± 10.8	
Age group	Breeder	85.7 ± 4.9	0.03	60.3 ± 12.8	0.89
	Heifer	77.4 ± 6.6		54.2 ± 10.5	
	Yearling	49.5 ± 16.0		63.0 ± 25.6	
Weight class	Low	69.2 ± 8.6	0.02	58.8 ± 11.3	0.93
	Medium	73.3 ± 7.9		59.8 ± 11.1	
	High	76.6 ± 7.3		59.2 ± 11.2	

## Discussion and conclusion

Pre-calving supplementation increased the probability that cows reconceived while lactating and indicated a benefit for conception within four months. Earlier and more frequent conceptions have cumulative effects, as cows that maintain shorter inter-calving intervals produce more calves and heavier weaners over their lifetime (Moorey & Biase 2020). These findings show that targeted nutritional support before calving can shift herd reproductive trajectories, contributing to long-term gains in fertility and productivity in Northern Australian beef systems.

## References

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<sup>A</sup> Corresponding author: l.pradaesilva@uq.edu.au

# Breedcow+ enables northern producers to model the effects of options to improve gross margins and improve land condition

*Niilo Gobius<sup>A</sup> and Bernie English*

Department of Primary Industries (DPI), Mareeba Qld 4880

## Introduction

In Northern Australia, long-term beef business performance is maximised when animal performance is optimised and stocking rate (SR) is matched to available pasture over time (McLean and Holmes, 2015). Income per animal and per enterprise is highly correlated to greater kg beef per animal, driven by improved reproductive efficiency, turnoff weights and reduced mortality rate. These improvements depend on good nutrition, most cost-effectively provided by sustainably grazed land in good condition. Breedcow Plus (<https://breedcowdynama.com.au/>) is an online software package designed to plan, evaluate and improve the profitability and financial management of extensive beef cattle enterprises. Current herd productivity, structure and turnoff figures, management, production costs and returns can be entered. Reproductive efficiency, mortality rates and profitability can be modelled and confirmed by records if available. The likely profitability of possible management changes aimed at improving enterprise kg beef/AE (Adult Equivalent; 450 kg animal) productivity can be evaluated before strategies are implemented, providing reassurance to graziers.

## Methods

Management changes aimed at improving growth, weaning and mortality rates, turnoff weights, and culling of pregnancy tested empty (PTE) cows were evaluated for three beef properties (1800 to 2400 AEs) in Queensland's Northern Gulf. Production benefits of the implemented changes on growth, weaning %, turn-off weights, and mortality were estimated from published research and Breedcow's internal modelling. Gross margins (GM) were calculated, maintaining stable herd SRs (AEs).

## Results

Breedcow modelling shows that a weaning rate of 60% enables culling all PTE cows. At lower rates culling reduces herd numbers. Improving weaning rates from 50% to 60% through heifer M8U supplementation from early weaning to the first wet season and then for a period in their second year was economically marginal but enables PTE culling. Supplementing the entire herd with phosphorus (giving greater weight gains, weaning rates and lower mortality) was always positive – lifting herd GM by up to 24% from non-supplemented herds. Delaying steer turnoff through to 3 years old (higher turnoff weights) improved GM by up to 21%. Culling 100% of PTEs had less of an impact on GM, improving GM by 1.5 to 15%. However, in combination these management practices could improve herd GM by up to 42%. Cattle numbers and hence SR (AEs) increases with improved weaning rates and delayed steer turnoff, so breeder numbers should be adjusted down. SR reductions of 25 to 30% can be undertaken, while maintaining GM equivalent to those achieved prior to improved management.

## Conclusions

Breedcow+ evaluations indicate that improved herd management specifically aimed at improving enterprise kg beef produced/AE, enables northern producers to significantly reduce SRs but maintain GM. This reduces grazing pressure, thereby facilitating land condition improvement or preservation.

## References

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<sup>A</sup> Corresponding author: niilo.gobius@dpi.qld.gov.au

# Observations of early calving history on a cow's third and fourth mating outcomes in a high fertility Brahman herd

Gretel Bailey-Preston <sup>A,D</sup>, Tim Schatz <sup>B</sup> and David Johnston <sup>C</sup>

<sup>A</sup> NT Department of Agriculture and Fisheries, Katherine 0850; <sup>B</sup> NT Department of Agriculture and Fisheries, Berrimah Farm 0800; <sup>C</sup> Animal Genetics and Breeding Unit, University of New England, Armidale NSW 2351.

## Introduction

Early puberty in heifers and success from the first two matings is correlated with increased lifetime fertility and overall productivity (Johnston et al., 2013). Data collected during the Repronomics I and II projects from a Brahman herd whose fertility has been improved by long term selection (Schatz et al., 2010) was used to investigate the impact of early calving history (first two mating opportunities) on the outcomes (pregnancy rates) from the third and fourth mating opportunities.

## Methods

The data from 1222 heifers over 12 years were used when investigating outcomes of the third mating, and data from 387 heifers (selected as replacements and reared third calf) were used in studying fourth mating outcomes. Replacements were chosen if they were empty once out of the first two mating opportunities, hadn't lost a calf, and were pregnant at the third opportunity. Heifers were first mated as yearlings at Douglas Daly Research Farm, NT, and mating was for three months from early January each year. Pregnancy testing and weighing was conducted at the weaning muster in May. Mating outcomes were classified as "Reared" if a calf was weaned, "Loss" if a pregnancy didn't result in a weaning of a calf, and "Empty" if a pregnancy did not result from a mating opportunity. Liveweights were corrected for the weight of conceptus (O'Rourke et al., 1991).

## Results

**Table 1. Results from the 3rd and 4th matings for cows with different early calving histories (Empty, Loss or Reared at the 1st and 2nd mating opportunities) \***

Calving History (1st, 2nd)	Pregnancy % 3rd	Pregnancy % 4th	Avg. LW (kg) at 4 Y.O (4 <sup>th</sup> pregnancy test)
Empty, Loss	90 (n=67)	NA	NA
Empty, Reared	79 (n=661) <sup>a</sup>	75 (n=138) <sup>a</sup>	393.7 (353.5-434.0) <sup>a</sup>
Loss, Reared	94 (n=50) <sup>b</sup>	NA	NA
Reared, Empty	99 (n=163) <sup>bc</sup>	86 (n=80) <sup>ab</sup>	385.0 (340.2-429.8) <sup>a</sup>
Reared, Loss	90 (n=21)	NA	NA
Reared, Reared	90 (n=251) <sup>d</sup>	89 (n=169) <sup>b</sup>	369.0 (325.1-412.8) <sup>b</sup>

\*Values without a superscript implies abcd. Values with a different superscript in a column have a p-value <0.05.

## Discussion and conclusion

Heifers that conceived from yearling mating were more likely to be pregnant after their third and fourth matings than heifers that did not conceive as a yearling but then reared their next calf, indicating superior genetics. Replacement heifers that successfully raised calves from their first two mating opportunities had the highest pregnancy rates from the fourth mating, and they had a significantly lower average weight at four years old than cows that had a "miss". This may be due to not having a year "off" rather than a lower mature size. Cows with smaller mature size also require less energy for maintenance, allowing more for reproduction. This is a preliminary analysis, not including fixed effects so further analysis is required to investigate effects of early calving history on fertility and profitability.

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<sup>D</sup> Corresponding author: gretel.baileypreston@nt.gov.au

# How many SNPs are required to perform multi-breed genomic predictions in Australian cattle populations?

C.L. Warburton<sup>A,C</sup>, R. Costilla<sup>B</sup> and B.J. Hayes<sup>A</sup>

<sup>A</sup> Queensland Alliance for Agriculture and Food Innovation, University of Queensland, St. Lucia Qld, 4072 Australia; <sup>B</sup> Cawthron Institute, Nelson 7010, New Zealand.

## Introduction

Genomic predictions assume that SNP alleles common between animals are inherited from a common ancestor (IBD). However, this may not be the case (IBS), especially in genetically diverse populations. The aim of this study is to determine if current high density (HD) SNP arrays are sufficient to identify IBD relationships in genetically diverse Australian cattle populations.

## Methods

Whole-genome sequence (WGS) data for Angus and Brahman cattle were sourced from the 1000 Bulls Genomes Run 9 dataset (Hayes & Daetwyler, 2019). High-density (HD) genotypes were extracted from the WGS data using the BovineHD array SNP. Haplotypes were generated using fixed 100 kb and 250 kb windows (Warburton et al., 2023). Identical HD haplotypes were classified as IBS; corresponding WGS haplotypes were compared, and the proportion of differing SNPs was calculated. Haplotypes with <1% SNP different were considered IBD. The number of SNP required to detect IBD across breeds was estimated by dividing the optimal haplotype window size by the bovine genome length (~3 Gb).

## Results

In Angus cattle, IBD relationships were detectable using 30 HD SNPs within 250 kb windows, requiring ~360,000 SNPs across the genome. Brahman and multi-breed populations needed 50 HD SNPs within 100 kb windows, or ~1.5 million SNPs. This reflects greater genetic diversity in Brahman and multi-breed populations, requiring higher SNP density for accurate IBD detection.

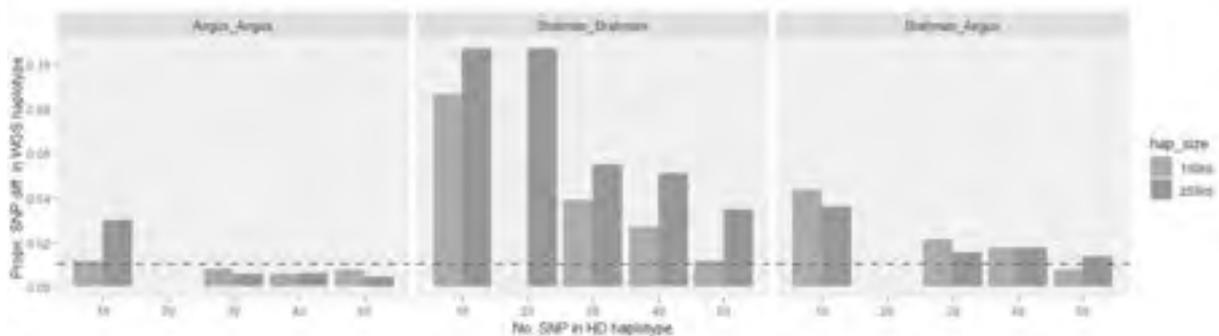


Fig. 1 Proportion of SNP different in whole genome sequence haplotype

## Discussion and conclusion

The BovineHD SNP panel consists of ~728,000 SNP, which was sufficient to identify IBD haplotypes between *Bos taurus* animals. However, in multi-breed and multi-subspecies populations approximately 1.5 million SNP are required.

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<sup>C</sup> Corresponding author: c.warburton@uq.edu.au

# Seasonal forecasting: a simple analysis of various statistical and weather model forecasts for Queensland

Dorine Bruget, John Carter<sup>B</sup>, Baisen Zhang, Grant Stone, Grant Fraser

Queensland Department of the Environment Tourism, Science and Innovation. Ecosciences Precinct, Dutton Park, Queensland, Australia.

## Introduction

Seasonal forecast systems have been used for many years to assist agricultural sector decision-making in Queensland; however, these systems lack easy to understand performance evaluation. This study presents an experimental analysis of these forecasts averaged across Queensland, by examining how often the ‘forecast’ tercile rainfall matches the ‘measured’ tercile rainfall (see example analysis; Fig. 1), while applying a simple weighting metric that accounts for successes and major failures.

## Methods

For each forecast system, rainfall forecasts (hindcasts derived from median of analogue years or median of ensemble members from weather models), were converted to a tercile ranking against historical rainfall (base 1980 to forecast year). Gridded datasets for the outlook period (e.g. rolling 3-month periods) were extracted from the SILO database and converted to a tercile rank using the same base period. The percentage of grid pixels in each forecast category was calculated, as was the percentage of correctly forecast terciles. A weighting factor was used to discount the worst forecasts (i.e. predicted top tercile, observed bottom tercile; and predicted bottom tercile, observed top tercile). Systems tested were ACCESS-S1 and ACCESS-S2, AADI, (ACCESS-S2 with improved bias correction and downscaling through the AADI project), SOI phase, SPOTA, SOI/IPO, SST index and persistence (i.e. rain received was same as previous year).

## Model results

Seasonal forecasting of correct tercile rainfall generally exceeded random chance (i.e. 33.3% correct for matching forecast/observation outcomes, but the best ‘in-use’ system [SOI Phase] is only 43% correct; Fig. 2, green bar). When adjusted for critical forecast failures, ACCESS-S1 and ACCESS-S2 performance substantially declined, however, the AADI downscaling / bias correction method improved. Considering rainfall alone, the statistical methods SOI phase and IPO/SOI are marginally better than downscaled model estimates.

		Example of SOI Phase		
		Rain	Correct	Correct
FORECASTS	Top Tercile	2.3 Weight 2.0	4.2 Weight 1.0	9.6 Weight 1.0
	Middle tercile	22.7 Weight 0.0	27.1 Weight 1.0	23.1 Weight 0.0
	Bottom Tercile	4.4 Weight 1.0	7.2 Weight 0.0	14.4 Weight 1.0
		Bottom tercile	Middle tercile	Top Tercile
OBSERVATIONS (percent correct)				

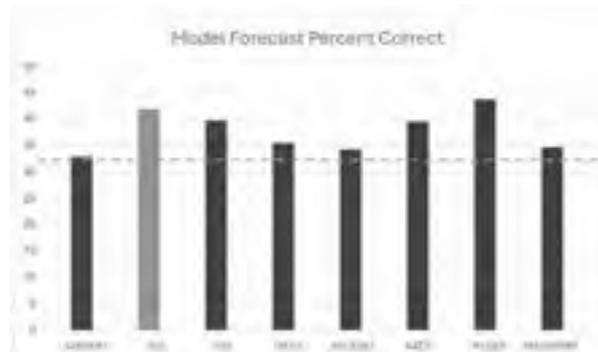


Fig. 1. Forecast and observed tercile rainfall.

Fig. 2. Performance of various forecast systems.

## Discussion and conclusion

Model skill, such as presented here, is only part of the assessment process. Issues, such as ease of forecast production, clarity of outcomes to the user, forecast impact on bio-economic outcomes, week-to-week changeability of forecast, and forecast skill at monthly (as opposed to seasonal scale) are all important factors in providing and communicating a workable/acceptable seasonal forecast to assist agricultural sector decision-making. The tercile matrix concept shown here provides a simple way for non-scientific users to objectively evaluate forecast skill.

<sup>B</sup> Corresponding author: [John.carter1@qld.gov.au](mailto:John.carter1@qld.gov.au)

# National Climate Risk Assessment – key messages for the Australian northern beef herd

Thomas Keogh <sup>A,C</sup>, Sabrina Greenwood <sup>B</sup>, Dianne Mayberry <sup>B</sup>

<sup>A</sup> CSIRO Agriculture and Food, Black Mountain 2601; <sup>B</sup> CSIRO Agriculture and Food, St Lucia 4067

## Introduction

The Australian northern beef herd is vulnerable to climate challenges because it is largely made up of extensively managed systems that are heavily reliant on rainfed pasture. The impacts of climate change on feed supply, animal productivity and animal health are likely to intensify under future climates, underscoring the need for innovative adaptation strategies. By assessing climate metrics relevant to Australian northern beef production, the National Climate Risk Assessment (NCRA) provides the foundation for quantifying risks and adaptation options.

This paper provides a brief snapshot of relevant results from the NCRA, with readers directed to the Primary Industries Technical Report (Darbyshire et al., 2025) for more detail.

## Methods

Climate projections were derived from the most recent generation of global climate models (CMIP6), expressed as Global Warming Levels (GWLs) of +1.5, +2.0 and +3.0°C above pre-industrial temperatures. Metrics for livestock include the number of heat stress days, based on a temperature humidity index (THI), and the frequency of hot spells per annum, defined by at least three consecutive days where maximum temperatures were  $\geq 34^{\circ}\text{C}$  and minimum temperatures were  $\geq 22^{\circ}\text{C}$ . We also assessed changes to wet and dry season rainfall patterns, which influence pasture production.

## Results

The number of heat stress days were projected to increase by up to 50 d per year with GWL +3.0°C. *Bos taurus* cattle are less tolerant of heat stress and are already exposed to around 150 d of heat stress annually, compared with about 30 d for *Bos indicus* cattle. Increases to the number of hot spells are greatest in northeastern Australia, with up to 9 additional hot spells per year with GWL +3.0°C projections. Rainfall projections remain highly variable, with no consistent shifts in wet or dry season totals.

## Discussion and conclusion

These projections indicate a likely decline in the carrying capacity and productivity of cattle in Northern Australia due to climate change. Hotter temperatures will likely reduce plant available water due to increased evaporation and reduce pasture quality. *Bos indicus* breeds may become increasingly dominant due to their heat tolerance, but at the cost of generally lower liveweight gain and carcass quality. Poorer animal condition and increased susceptibility to disease will compound producer risk, especially during extended dry periods. The projected changes highlight the urgency for research and innovation to support northern beef producers as they navigate a warming climate. Priorities include the development of early warning systems to support timely destocking and adopting grazing management strategies that protect land condition and feed resources.

## Acknowledgements

The NCRA primary industries assessment was led by Rebecca Darbyshire. Andrew Bolt, Lara Buhagiar, Dean Holzworth, Neil Huth, Andrew Paroz and Julian Rich created and processed the data workflows and conducted all projection analyses.

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<sup>C</sup> Corresponding author: [thomas.keogh@csiro.au](mailto:thomas.keogh@csiro.au)

# Understanding FORAGE report user experience to improve its use for grazing land management decision-making

Fiona McCartney<sup>B</sup>, John Carter, Grant Fraser, Grant Stone and Christina Jones

Department of the Environment, Tourism, Science and Innovation, Dutton Park 4102

## Introduction

Since 2011 the Queensland Government’s Long Paddock website has provided users with property-scale FORAGE reports relating to factors such as ground cover, land types, pasture growth, seasonal pasture outlooks and long-term carrying capacity, to assist with agricultural and environmental decision-making on primarily grazing lands (Zhang & Carter 2018). The number of FORAGE reports requested has continued to increase over time, however, the ways that these reports were being utilised was not well known. A greater understanding of their use, and users’ experiences with them, was required to inform the continuous improvement of these well-established decision support tools.

## Methods

This social research project employed a two-phase mixed methods approach of a quantitative online usability survey and qualitative user experience interviews with selected power users.

## Results

The study recorded detailed data about: who was using the FORAGE reports; why the reports were being used; how they were being used; and whether they are likely to recommend the reports to other users (Fig. 1). In addition, user experience feedback was collected regarding: their perceived utility (*whether the FORAGE reports are useful*); usability (*whether they are easy to use*); and credibility (*whether their data and information is trustworthy and reliable*) (Morville 2004).

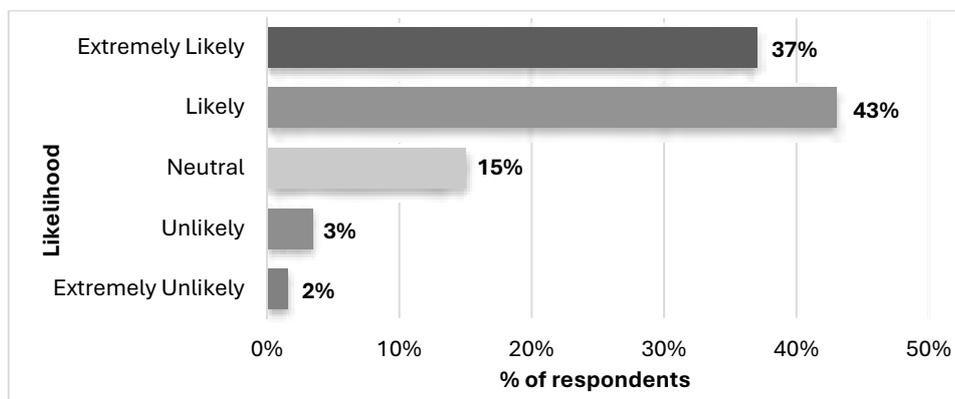


Figure 1. Likelihood to recommend the FORAGE reports to other users

## Discussion and conclusion

Findings and actionable insights from this study are already being applied to enhance the suite of FORAGE reports. Furthermore, this is an example of how user experience and social science can support the continuous improvement of existing decision support tools, leading to better industry uptake and informed decisions for sustainable land management and improved paddock performance.

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<sup>B</sup> Corresponding author: [fiona.mccartney@detsi.qld.gov.au](mailto:fiona.mccartney@detsi.qld.gov.au)

# Biodiversity into focus: ESG metrics and reporting in the beef sector

Ana Carla Leite de Almeida<sup>B</sup>

Tropical North Queensland Drought Resilience Adoption and Innovation Hub, The Cairns Institute, James Cook University, Townsville, Australia

## Introduction

Australia's ESG landscape is rapidly evolving, with climate disclosures moving from voluntary to mandatory. While ESG reporting is not yet required at the farm level, it is becoming increasingly important for beef producers seeking market access. Biodiversity underpins critical ecosystem services but remains largely invisible in existing agricultural ESG frameworks, creating long-term risks to productivity, resilience, and trade opportunities.

## Methods

We conducted a systematic literature review using PRISMA (2020), screening 1,041 peer-reviewed articles from Web of Science and Scopus (2015–2025). Thematic coding in NVivo was used to explore: (1) how biodiversity is addressed in ESG frameworks; (2) indicators used to assess biodiversity risks and impacts; and (3) gaps in ESG reporting across beef supply chains.

## Results

Overall, our review indicates that biodiversity remains frequently marginalised in ESG frameworks for beef production, which predominantly focus on Scope 3 greenhouse gas (GHG) emissions and other climate-related metrics. When biodiversity is addressed, it is often captured only indirectly, via proxies such as land use change or deforestation risk, rather than through direct indicators of species richness, habitat integrity, or ecosystem function. Notably, alignment with the Kunming–Montreal Global Biodiversity Framework (GBF) peaked at just 37% across reviewed ESG tools (Zhu & Carrasco, 2025), highlighting substantial gaps in coverage. A range of tools, including Life Cycle Assessment (LCA), Analytical Hierarchy Process (AHP), System of Environmental-Economic Accounting (SEEA), and TNFD-aligned risk assessments, were identified as promising for advancing biodiversity integration (Mayberry et al., 2024; Ingram et al., 2022). However, these approaches are still evolving, and many remain too complex, poorly standardised, or disconnected from producer-level data systems. As a result, biodiversity-specific metrics are still largely absent from procurement, investment, and reporting processes across beef supply chains.

## Discussion and conclusion

Biodiversity is essential to beef production resilience but remains a blind spot in ESG reporting. Key barriers include a lack of standardised indicators (aligned with TNFD/GBF), limited region-specific data, and fragmented governance across the value chain. Although frameworks like SEEA and TNFD offer promise, they are underused and disconnected from farm-level practice. ESG systems must evolve to embed biodiversity through natural capital and place-based metrics. Without reform, ESG risks reinforcing greenwashing and failing to support biodiversity goals in high-impact sectors like beef.

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<sup>B</sup> Corresponding author: [ana.leitedealmeida@jcu.edu.au](mailto:ana.leitedealmeida@jcu.edu.au)

# Combining reproductive and genomic biotechnologies to further improve beef production

Laercio R Porto-Neto<sup>A,C</sup>, Pamela A Alexandre<sup>A</sup>, Antonio Reverter<sup>A</sup>, Marina RS Fortes<sup>B</sup>

<sup>A</sup> CSIRO Agriculture and Food, St Lucia, QLD 4067; <sup>B</sup> The University of Queensland, SCMB, St Lucia, QLD 4072

## Introduction

The term "sustainable animal production" has business and environmental dimensions that are increasingly challenging to address due to climate change, social pressures, and rising production costs. The use of strategies to increase production efficiency, generating more products with fewer resources (inputs) and minimal waste, results in improved sustainability in the broad term. Genetic improvement is a well-established method for enhancing efficiency, as it is permanent and cumulative (Mueller and Van Eenennaam, 2022). When combined with reproductive and new breeding technologies (e.g. gene editing), it becomes a very powerful tool.

## Assisted Reproductive Technologies (ART)

ART is a well-established field of science, comparatively more mature than most genomic technologies. The use of ART enables greater selection intensity and shorter generation intervals, both key drivers of genetic gain. Several reproductive technologies are available to producers seeking to improve breeding efficiency or multiply desirable animals; they have different requirements that reflect on the complexity of their implementation.

## Genetic and genomic technologies

Genetic technologies aim to identify the best animals to meet breeding objectives. Candidates can be ranked using pedigree-based estimated breeding values (EBV) or by GEBV derived from genomic selection (GS). Genomic selection can be applied to calves, embryos, or even cell lines, which could be used for animal cloning, an ART. At the cutting edge of genomic technologies is gene editing. This challenging technology can introgress a desirable genetic variant into an animal's genome without disrupting previous selection.

Low technology	Medium technology	High technology
Genomic EBV + AI	Genomic EBV + FTAI	Gene editing + cloning
Genomic EBV + AI	Genomic EBV + IVF	Gene editing + IVF
High penetration		Low penetration
Rapid improvement		Generate great animals
Technology ready to use (or near to)		Under development

**Figure 1. The combination of reproductive and genomic technologies at different complexity levels and their "readiness" for implementation.**

## Discussion

There is a synergistic relationship between reproductive and genomic technologies, where one identifies the best breeding pairs and the other facilitates their multiplication. This combination speeds up genetic gain in the herd by favouring higher selection intensity and allowing the selection of younger animals, thereby reducing the generation interval, both known factors affecting genetic gain. These biotechnologies are available to producers at different entry points of complexity (Figure 1); "one solution" doesn't fit all. There are multiple technology combinations that can be explored.

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<sup>C</sup>Corresponding author: laercio.portoneto@csiro.au

# Pilbara Extension Network: Producer-led research and extension in the Pilbara beef industry

Liz Moss <sup>A</sup>, Pastoral Participants from the Extension Network

<sup>A</sup> Pilbara Innovation Partnership, Karratha, WA, 6714

## Introduction

The Pilbara Extension Network (PEN) was established in 2024 under the Pilbara Innovation Partnership, funded by the Department of Primary Industries and Regional Development, Meat & Livestock Australia, and Rio Tinto. PEN responds to long-standing challenges in building locally relevant research, development and adoption (RD&A) in northern beef systems. It aims to test whether producer-led extension models can accelerate innovation and deliver practical, enduring outcomes for stations.

## Methods

Seven pastoral stations were contracted to design and deliver research projects of regional significance. Each station nominated a staff member as project lead and participated in structured capacity-building modules focused on project design, monitoring, communication and collaboration. Projects aligned with national and regional R&D priorities, including genetics, grazing management, pasture monitoring, drought planning and biodiversity. Co-contributions from producers and partners strengthened the investment base and linkages with universities and industry bodies.

## Results

The PEN projects demonstrated how producer-led trials can build capability while generating research value. Each station designed a project that reflected its priorities — from rangeland genetics to satellite-based pasture monitoring, grazing and land management, drought planning and biodiversity. These trials produced station-specific insights and data, but their greater value lay in how staff built the skills to scope, deliver and interpret research on the ground.

## Discussion and conclusion

PEN highlights the value of embedding research capacity within stations to ensure outcomes are directly relevant and adopted. The core lesson is that people are the foundation of innovation: when station staff are supported to design and deliver projects, they develop the skills, confidence and networks to keep driving change. Flexible design and sustained support were critical to building this capability, while the trials provided practical entry points into broader R&D pathways

The most important outcome is local ownership. Producers are not only implementing trials but also presenting their experiences, reflecting pride in their projects and commitment to shaping future R&D. The next stage is about strengthening these producer networks, linking Pilbara projects into national initiatives, and extending the model to other regions where building capability is key to adoption. Due to strong demand, the PEN program will continue with a new cohort in 2026–27.

<sup>A</sup> Corresponding author: Liz.Moss@dpird.wa.gov.au

# Building research capacity and capability in the north: the new Research Institute for Northern Agriculture at Charles Darwin University

Beth Penrose<sup>A,B,C</sup>

<sup>A</sup> Research Institute for Northern Agriculture, Charles Darwin University, Darwin, NT 0820, <sup>B</sup> CSIRO Livestock and Aquaculture, Darwin, NT 0828

Northern Australia is characterised by its remote landscapes and sparse populations. Despite this, Northern Australia is an agricultural powerhouse, with a beef herd of >13.5 million head, and is important for the horticultural and aquacultural industries. Northern Australia is also the first line of defence for biosecurity, being only 160-550 km from our nearest neighbours Papua New Guinea, Timor Leste and Indonesia. Despite its importance, there are only two universities physically located  $\leq 20^\circ$  South; James Cook University in Townsville and Cairns (JCU; Queensland) and Charles Darwin University (CDU; Darwin, Nhulunbuy and Alice Springs). James Cook University has a long history of excellent veterinary teaching and research, whereas Charles Darwin University's focus on agriculture has been on vocational education and environmental science or social science research adjacent to primary production. Nevertheless, there has been limited research and teaching in agriculture from universities situated in the tropics.

To fill this gap, Charles Darwin University applied for a Regional Research Collaboration Program grant from the Australian Government Department of Education in 2021, and in 2023, the Research Institute for Northern Agriculture (RINA) was born. Based in Darwin, the remit of RINA is to build research capacity and capability for the north, in the north, through research projects and student training (PhD, Honours and Masters). Four research groups make up RINA (Fig. 1) and include Sustainable Pastoral Systems and Tropical Biosecurity, which are highly relevant to the northern industry.



**Fig. 1.** The four research groups that make up the Research Institute for Northern Agriculture

The current foci of these groups include making the northern pastoral systems more sustainable, landscape productivity and grazing management, protecting biodiversity and natural capital in the rangelands and insects as disease vectors. Research projects that have already started include developing eDNA sampling protocols for detection of animal diseases from on-farm water sources, recycling of inorganic waste on remote cattle properties, and virtual fencing for biodiversity and natural capital.

As of October 2025, RINA has commenced 9 PhD students and 3 Honours students and has attracted >\$10 M in grants. With the help of the steering committee members, NT Department of Agriculture and Fisheries, Northern Territory Cattlemen's Association, NT Farmers, Murdoch University, James Cook University and Central Queensland University, it's hoped that this capacity and capability building can continue for and from the north.

<sup>C</sup> Corresponding author: Beth Penrose ([beth.penrose@cdu.edu.au](mailto:beth.penrose@cdu.edu.au))

# Ramping up extension delivery as pasture dieback spreads south

Ted Callanan <sup>B</sup>, Gavin Peck, Vanessa Macdonald

Department of Primary Industries, Toowoomba 4350

## Introduction

Pasture dieback causes the premature death of productive sown grass pastures across areas of eastern Queensland and New South Wales. It has been spreading to new areas in southern Queensland (SQ) since 2018 and more notably since 2023. Successful extension of recommended management options to restore productivity on affected paddocks has been conducted since 2015 by the Department of Primary Industries (DPI), but mostly in central Queensland. From 2024 to 2025, the extension program in SQ has aimed to help producers accurately identify pasture dieback and manage affected pastures back to productivity.

## Methods

During the period from March 2024 to June 2025, ten targeted on farm extension events were delivered to beef producers and industry personnel. On-farm events were hosted by producers with existing networks in the local district. Four guest presentations were also delivered as part of producer workshops, hosted by other projects or organisations. One Beef Connect webinar was delivered to online attendees in collaboration with the DPI pasture dieback experts from north and central Queensland.

## Results

There were 88 attendees at the four guest presentations and 105 for the webinar. A total of 270 attended the ten on-farm extension events with 130 completing a feedback form. Of the respondents, 98% learnt something new, with 100% indicating an increase in their knowledge on the topic. The events achieved a value rating of 6 out of a possible score of 7 for the information provided, 6.4 out of 7 for overall satisfaction with the event and 61% of respondents intended to make a change to their management across a total of 41,261 hectares. Extension events were further supported by online resources hosted on the FutureBeef pasture dieback web page that has seen a significant increase in visits between February 2024 (1,500) and May 2025 (11,500).

## Discussion

The ongoing spread of pasture dieback across southern Queensland and increase in the severity of pasture dieback impact in certain areas has increased the demand for targeted extension services. The extension strategy used in SQ closely aligns with previous DPI pasture dieback extension developed and delivered in 2020-21 (Hopkins *et al* 2022). Results indicate the extension methods employed to date have provided value to producers. As producers move beyond their initial search for information on the topic towards longer term management options. Our extension strategy is also adapting tailored information on improving pasture production and resilience in the presence of pasture dieback.

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<sup>B</sup> Corresponding author: ted.callanan@dpi.qld.gov.au

## FutureBeef—widely valued, driving practice change

Nicole Sallur<sup>A, F</sup>, Jodie Ward<sup>B</sup>, Felicity McIntosh<sup>C</sup>, Kate Brown<sup>C</sup>, Melissah Dayman<sup>D</sup>, Alice Bambling<sup>E</sup>, Greg Bath<sup>C</sup>

<sup>A</sup> Department of Primary Industries (DPI), Charleville, Qld, 4470; <sup>B</sup> DPI, Gympie, Q 4570; <sup>C</sup> DPI, Brisbane, Qld, 4001, <sup>D</sup> DPI, Gayndah, Qld, 4625; <sup>E</sup> DPI, Emerald, Q, 4720

### Introduction

FutureBeef is a collaboration between the Queensland Department of Primary Industries, Northern Territory Department of Agriculture and Fisheries, Department of Primary Industries and Regional Development Western Australia and Meat & Livestock Australia. It plays a critical role for the Northern Australian beef industry, by providing timely and relevant information through a mix of digital channels including the FutureBeef website, webinars, eBulletin and social media platforms.

### Methods

A mid-term review was conducted to assess the performance, relevance and impact of FutureBeef. Evidence was gathered through an online survey (n=148) and interviews (n=105) with producers (n=74), as well as with service providers, stakeholders, Advisory Committee members and the FutureBeef team (n=31). The online survey was promoted through the FutureBeef eBulletin and social media channels, while participants for the phone survey were gathered from a random sample of eBulletin subscribers.

### Results

Key findings from the mid-term review were:

1. **FutureBeef is widely valued** as trusted and credible source of technical information, especially the eBulletin and website.
2. **Over 60% of producers** surveyed had made, or intend to make, practice changes based on FutureBeef resources.
3. **The platform's reach and usability could be improved.** Many producers were unaware of available tools. Others described the website as difficult to navigate and relied on Google instead of the internal search function.
4. **Content relevance varies by region and enterprise type.** Producers from the NT and WA called for more locally tailored information, while small-scale operators sought content suited to their scale.
5. **There is high goodwill and support** from producers, service providers and stakeholders, who view FutureBeef as a valuable asset for the northern beef industry.

The mid-term review identified key areas for improvement, sorted by priority, with targeted recommendations in each. The high priority recommendations are:

1. Improve awareness and promotion.
2. Upgrade website search and navigation.
3. Present information in bite-sized layers.
4. Increase eBulletin frequency.

Full details of the mid-term review including results and recommendations can be found at: <https://futurebeef.com.au/resources/futurebeef/>.

### Discussion and conclusion

FutureBeef plays a vital role in supporting the northern beef industry through its accessible, evidence-based content and multi-channel delivery model. With strong foundations in place, there is clear opportunity to improve usability, reach, and impact through targeted refinements and strategic investment. Strengthening relevance for diverse users will ensure FutureBeef continues to inform and enable a productive, resilient northern beef industry into the future.

<sup>F</sup> Corresponding author: [nicole.sallur@dpi.qld.gov.au](mailto:nicole.sallur@dpi.qld.gov.au)

# **Queensland Pastures e-newsletter increases beef industry engagement**

Kylie Hopkins<sup>B</sup>, Stuart Buck

Department of Primary Industries, Rockhampton 4702

## **Introduction**

In 2023, the 5-year Queensland Pasture Resilience Program (QPRP) was launched to address livestock industry threats such as land condition decline, pasture rundown, and pasture dieback through a state-wide integrated research, development and extension (RD&E) program. QPRP is delivered by the Queensland Department of Primary Industries (DPI) through a partnership between Meat and Livestock Australia (MLA), the DPI and the Australian Government through the MLA Donor Company. The aim of the QPRP is to increase adoption of improved pasture management practices across Queensland. The extension component engages with producers and industry personnel through awareness raising activities, face-to-face and online. Email newsletters (e-newsletters) are regularly used to communicate with an agricultural industry audience, however none were specifically targeted to people interested in pastures across Queensland. In 2024, the *Queensland Pastures* e-newsletter was created to provide timely management advice, industry updates and research findings from the QPRP. This paper reports the development and progress of the first six issues of *Queensland Pastures*.

## **Methods**

The subscriber list was initially generated by advertising in existing e-newsletters, at events, and on social media. The Vision6™ platform was used to manage subscriptions and create and deliver the newsletter. Four issues were published each year, featuring updates from all QPRP teams across the state. Each issue included a three-month activity summary, photo gallery, new articles and resources, and a list of upcoming events, all hosted on the FutureBeef website and linked from the newsletter. Subscriber numbers, open rates (number of subscribers who open the newsletter), and click rates (number of times newsletter links are clicked) were recorded.

## **Results**

In six issues, subscriber numbers have increased from 291 at Issue 1 in March 2024, to 582 just prior to the release of Issue 7 in September 2025. The average open rate was 73.8%. A total of 39 articles have been published and 10 new resources launched including factsheets, guides, podcasts and videos. The article with the highest click numbers was about planting new legume trial sites across Queensland, published in Issue 5. The photo gallery of staff undertaking RD&E activities was consistently in the top five clicked links in every issue.

## **Discussion and conclusion**

The growing subscriber list and consistently high open rates, well above similar industry e-newsletters (MailChimp 2019), has demonstrated a need for an e-newsletter for people interested in timely information about pastures in Queensland. As there has been limited promotion of the newsletter its subscriber numbers have grown organically through word of mouth. Quarterly issues were regular enough to allow contributors to produce a range of scientific and human-interest articles and downloadable resources that were seasonally relevant for readers, but not too regular to feel like spam. Using the newsletter to launch new resources and publish industry announcements has created a 'see it here first' feeling by establishing a direct line of contact between the DPI and readers. Using the FutureBeef website as the host for articles and resources has not only leveraged the trust of the FutureBeef brand but further widened the audience for *Queensland Pastures* content.

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<sup>B</sup> Corresponding author: kylie.hopkins@dpi.qld.gov.au

# The value of knowledge diversity – What if I am wrong?

*Marcia Smith*<sup>A</sup>

Department of Primary Industries, Toowoomba 4350

## Introduction

Pick a topic relating to the beef industry that you have an opinion on; think about how life experiences have shaped your knowledge about that topic to inform the opinion you have today. Is your knowledge diverse, or has your opinion been inadvertently skewed toward one perspective? I was often guilty of this and still am at times, it is part of being human and a result of how we live our lives.

## Discussion and conclusion

The purpose of science is to test a hypothesis in order to inform and draw conclusions about the research question asked. Research has informed us that diversity of plants in a pasture is important for growing quality forage and maintaining soil health; diversity of investments is important for growing financial security; and diversity of cattle breeds is important to ensure stock are adapted to the various environments in which they graze. In the same vein, being open to and researching a diversity of perspectives is important for growing knowledge.

I first heard about the Black Swan metaphor on The Plant Free MD podcast. The metaphor is based on the presumption that all swans were white because, prior to 1697 when European explorers first saw black swans in Western Australia, the black swan didn't exist... or did they? This got me thinking about my opinions, my knowledge, what I believed to be true, and how I share those beliefs through my extension work. So, my New Year resolution for 2023 was to ask myself the simple question, "What if I am wrong?" at least once each day.

Questioning my own opinion and knowledge was initially daunting, fun and unsettling. It took effort and acknowledgment of my cognitive biases to actively listen to and consider opinions and learn about topics from people whose opinions and knowledge challenged mine. Apparently, there are many ways to plant and establish a pasture; nature can do it, humans can do it (with the help of nature) using drones, planters, spreaders. There are numerous grazing management practices used that result in profitable, productive, and sustainable beef businesses. I have recommended various methods to manage overland waterflow to prevent erosion, yet I am aware of many other effective interventions. Each time I engage with different perspectives, I gain appreciation for the diversity of approaches that can achieve the same goal.

Undertaking research and on-ground trials to ask, "is it true?", are critical to improve knowledge and understanding. I do not know what – or how much – I don't know, but my mind is more open than in the past, and actively diversifying my knowledge continues to add value to my work and life in general. Over time I have become comfortable with discomfort, and now approach questioning as a way to diversify my understanding of all manner of things.

Challenge yourself to step out of your comfort zone and ask, "What if I'm wrong?". To question your own knowledge and opinion is daunting and sometimes uncomfortable, but likely to deliver better outcomes and much more fun than the usual New Year resolutions!

<sup>A</sup> Corresponding author: [marcia.smith@dpi.qld.gov.au](mailto:marcia.smith@dpi.qld.gov.au)

# Strengthening the beef industry's drought, business, and financial resilience through the Advancing Beef Leaders program

Natalie Hughes<sup>B</sup>

Farm Business Planning North Queensland, Townsville 4818

## Introduction

Drought represents an ongoing constraint to the long-term sustainability of beef enterprises, where financial resilience and strategic planning are key factors influencing adaptability and recovery potential. Advancing Beef Leaders (ABL), a six-module leadership and professional development initiative partially funded through the Commonwealth and Queensland Government's Farm Business Resilience Program, supports emerging primary producers and aspiring beef industry and rural leaders. Through targeted training in financial literacy, risk management, and practical planning tools, the *Business and Financial Fundamentals* module strengthens both individual businesses and their communities in the face of climatic and economic pressures.

## Methods

In 2024, 22 ABL participants from across Queensland undertook 3 online workshops delivered over 3 weeks. Participants individually completed an Extensive Grazing Self-Assessment Checklist prior to the sessions to identify their business' deficits, strengths and 3 priority areas for improvement. Two initial sessions addressed common financial considerations, accounting options, financial statements, budgeting, and business management best practice. The final session introduced holistic business planning. Participants were guided through setting realistic goals, minimising risk through evidence-based strategies, and structuring task planning across 4 key areas: Production, Natural Resource Management, Business, and Human Resources and Relationships. Small group facilitated peer-to-peer discussions enabled attendees to share lived experiences of drought, disaster, and business challenges, and to explore evidence-based strategies suited to their regions.

## Results

The principal outcome was development of a two-page plan documenting identified risks, strategies, and measurable goals. Each plan received professional feedback, and several participants expanded these into QRIDA-eligible Farm Business Resilience Plans with guidance from the module facilitator. A post-module survey also reported notable improvements in confidence and understanding of business fundamentals, indicated by a mean positive shift of 1.59 points on a 7-point Likert scale. Participants rated the information provided in the module as highly valuable in assisting them to conduct their business (mean score of 6.18 out of 7) and reported strong intent to implement identified changes within the next 12 months (mean score of 5.87 out of 7). Qualitative feedback highlighted practical applications, including the intent to "implement actual strategies...with follow-through," "review and update business plans," and apply "evidence-based decision making." The majority of participants expressed commitment to further upskilling and periodically working on their businesses, integrating financial monitoring with operational decision making.

## Discussion and conclusion

The module demonstrates the value of combining financial literacy, business planning, and peer-to-peer learning within a leadership development setting. Participants improved their understanding of business fundamentals and produced practical two-page plans, with several advancing to full Farm Business Resilience Plans. The peer learning component additionally allowed strategies to be tested against lived experience and regional challenges. The ABL module not only builds confidence and resilience at the individual enterprise level but also contributes to the broader capacity of the beef sector and rural communities' ability to adapt to climatic and economic pressures.

<sup>B</sup> Corresponding author: natalie@fbpnq.com.au

# Research to reality: investigating barriers to on-station practice change

Stacey Holzapfel<sup>B</sup>, Christie Pearson, Jaidyn Eastaughffe

Northern Territory Department of Agriculture and Fisheries, Katherine Research Station 0850

## Introduction

Adoption of research by northern beef producers is generally considered to have been low and the processes involved in management recommendations being understood, adapted, and implemented on-station require greater clarity. The recommendations must make it across the “researcher-producer gap”, and every property has a unique environment, starting point, risk appetite, capabilities and goals. In addressing the issue of low adoption, Northern Territory Department of Agriculture and Fisheries (DAF) staff designed the StationSmart project (funded by the Northern Hub until June 2026). It involves a commercial station implementing proven management recommendations to reach a goal of their choice, with support from research and extension staff, and documenting the process.

As part of the project, DAF staff drafted a “ladder of capability” model. It is an attempt to sequentially list things a producer might have to address before and during the process of implementing a practice change. Practices high on the “ladder” require those below them to already be in place before they can be achieved. For example, matching stocking rates to carrying capacity is higher on the “ladder” than things like recording cattle numbers and obtaining property maps, as these things are required first. Developing the “ladder” highlighted a couple of things. Firstly, researchers may overlook practical barriers to adoption. Secondly, many research outcomes target the top of the “ladder”, expecting properties to already have preceding practices in place.

## About the project

In June 2025, a property in the Victoria River District identified a production goal and the changes they needed to make to achieve it. The goal was to improve weaning rates by removing non-performing breeders and better matching stocking rates to carrying capacities. The plan was backed by research, and results from a neighbouring property that had improved production through similar steps. First the property had to address lower steps on the “ladder” such as implementing a way to identify non-performing animals, making sure that staff understood the process and implications of doing this effectively. They also needed to collect spatial and pasture data to more accurately calculate carrying capacities. In addition, with the assistance of DAF staff they were able to fit GPS collars to cattle to gather grazing behaviour data. DAF staff ensured that the station management team understood the science behind the strategies so that they could choose methods that fit their system with the best chance of delivering results. Data is being collected to measure and document the impact, benefits and challenges of the practice change.

StationSmart is largely an extension-focused project, with the aim to use the StationSmart property as an open case study for others to learn from. The project team and DAF extension staff designed a detailed extension plan which includes: two written case studies; a review of information available on steps along the “ladder of capability”; a producer group that receives regular project updates, encouraging discussion; and inviting managers to share their experiences through, e.g., radio interviews or short videos.

There are three main extension-related outcomes that this project hopes to have achieved by June 2026. That the property has benefitted from this collaboration through increased capability and productivity, that the broader pastoral industry is better informed on all “ladder of capability” steps, and that researchers have a better knowledge of barriers to adoption.

<sup>B</sup> Corresponding author: stacey.holzapfel@nt.gov.au

# **The Northern Breeding Business program – Peer to peer learning fostering the adoption of improved cattle grazing business management practices and technologies in the Fitzroy River catchment**

*Ryan Honor<sup>B</sup>*

Department of Primary Industries, Rockhampton 4701

## **Introduction**

The Northern Breeding Business (NB2) program is a producer-driven research, development, and adoption program and joint initiative of Meat and Livestock Australia (MLA) and the North Australia Beef Research Council (NABRC). The aim of the NB2 program is to improve the long-term productivity, profitability and sustainability of the Northern Australian beef industry by helping businesses adopt improved practices in; enhanced breeding herd performance through improved systems and interventions, optimising feed production and supply, exploring sustainable rangeland management and on-farm practice change. The Fitzroy NB2 pilot group was formed with the aim of exposing members to information and technologies that would foster the adoption of practices that align with the NB2 objectives of increasing productivity, sustainability and profitability.

## **Methods**

Queensland Department of Primary Industries extension officers were appointed to create and facilitate a peer-to-peer learning group with the assistance of a producer coordinator. The group consisted of ten grazing businesses from across the Fitzroy River catchment of central Queensland, Australia. Quarterly face-to-face group meetings were conducted from February 2022 to June 2024. Business records were initially collected using standardised templates to establish baselines of herd productivity, feed base production and business profitability. Knowledge gaps in the use of improved grazing management technologies and marketing of niche cattle breeds were identified by the group. Subject matter experts were then invited to group meetings to provide the specific information members required to fully adopt improved grazing land management and cattle breeding practices. Upon conclusion of the NB2 pilot project in June 2024, the ten businesses were individually surveyed to analyse management practice changes within the group.

## **Results**

As a result of involvement in the project, all businesses improved their use of various herd recording and grazing land management technologies and showed interest in emerging sustainability issues. Consequently, 50% of the group made significant breeding herd practice changes by introducing Wagyu and other *Bos taurus* cattle to target market premiums. One business increased profit from their weaner production enterprise by 63% following the introduction of Wagyu genetics suiting niche market specifications. The remaining 50% of the group made significant changes in grazing land management practices by becoming efficient in pasture budgeting and matching stocking rates to carrying capacity.

## **Discussion and conclusion**

The peer learning process was based upon all businesses sharing a common goal to increase productivity, sustainability and profitability. This fostered constructive group discussion and feedback, leading to the formation of key performance indicators for each member's business. In conclusion, the Fitzroy NB2 pilot group was successful in exposing members to information and technologies that fostered the adoption of significant management practice changes.

<sup>B</sup> Corresponding author: ryan.honor@dpi.qld.gov.au

# Producer-focused demonstration site increases engagement in northwest Queensland

Greta Dunne<sup>A,D</sup>, Mick Sullivan<sup>B</sup> and Kylie Hopkins<sup>C</sup>

<sup>A</sup> Department of Primary Industries, Cloncurry 4824; <sup>BC</sup> Rockhampton 4700

## Introduction

In 2024, the McKinlay Shire in northwest Queensland experienced higher-than-average rainfall, including unseasonal winter rain. This out-of-season rain led to a decline in pasture quality and in turn livestock body condition scores (BCS), resulting in low pregnancy rates in 2025. Concerned by these impacts, a next-gen local producer contacted the Department of Primary Industries (DPI) Beef Extension team in Cloncurry, asking for assistance on managing the growth and nutrition of young female cattle in difficult conditions. An on-farm demonstration site was established with the producer aiming to help local graziers understand pasture quality in response to season conditions and the nutritional impacts on cattle.

## Methods

From February to August 2025, a cattle faecal sample was collected monthly from a paddock at two properties on Mitchell grass downs in the McKinlay Shire, northwest Queensland. For each collection, a tablespoon-sized sample of faeces was taken from at least 10 dung pats in the paddock and combined. The samples were dried and analysed for crude protein (CP) and dry matter digestibility using near-infrared spectroscopy (F.NRIS). Rainfall data was recorded at each site using Farmbot™ rain gauges. A group of neighbouring producers were invited to one of the host properties for a 'neighbour day' in June 2025 to share the results and discuss management options. The neighbour day also included practical demonstrations on cattle grass intake, nutritional requirements of breeders and supplementation options to manage CP and DMD deficits.

## Results

CP% declined from February to August, resulting in a drop from 16.8% to 3.6% at South McKinlay and 15.3% to 3.0% at North McKinlay. In both paddocks, DMD also declined in the same period, but remained over 52%. The neighbour day on 26 June was attended by 7 people from 5 properties. Discussions on the day resulted in 4 out of 7 attendees planning to make changes to their supplementation and breeder management programs.

## Discussion and conclusion

The data collected from the host property aligned with existing scientific understanding of the decline in Mitchell grass quality during the dry season, particularly following out-of-season rainfall (Scarnecchia and Partridge, 1994). However, the use of local data helped next-gen producers and DPI Beef Extension Officers to better understand the nutritional demands of their cattle and the critical role of strategies such as supplementation, and the time of calving and weaning. The neighbour day provided a platform to discuss a range of practical topics, including cattle nutrition, lick intake management, interpreting F.NRIS results, and understanding supplement composition. The event has promoted connections between producers and the DPI Beef Extension Team. By addressing shared challenges through a practical, local demonstration, the site proved effective in bringing people together. Efforts are underway to continue hosting neighbour days. This demonstration site has become a hub for producers to share knowledge, ideas, and challenges, with facilitation and guidance provided by DPI Beef Extension Officers.

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<sup>D</sup> Corresponding author: greta.dunne@dpi.qld.gov.au

# Developing a formal staff induction and mentoring program for the Department of Primary Industries extensive livestock systems RD&E work group

Megan Willis<sup>B</sup>

Department of Primary Industries, Townsville, Qld, 4814

## Introduction

It was identified in 2023 that there was a strong demand for a structured induction and mentoring program for the extension and technical profession within the Department of Primary Industries (DPI) Extensive Livestock Systems RD&E work group (Hick et al., 2023). The objective was to support career development, build extension capability, and foster more effective engagement with producers across Queensland as part of a foundational training program. Such a program would build staff capability and confidence, enabling early-career officers to “hit the ground running”. This fits well with the implementation of DPI’s Grazing Extension Practice as a framework that applies grazier-centred extension delivery and approaches to increase the frequency and reliability of graziers investing in improved management practices (Willis & Nelson, 2023). Once established, the program could be adapted for broader audiences. The Queensland Reef Water Quality Program funded a structured mentoring program for DPI extension and technical staff and the development of a structured induction program with online resources.

## Discussion

The Grazing Extension and Technical (GET) Mentoring Program was implemented in November 2024. Ten mentors and ten mentees participated in a six-month program with in-person and online sessions. Outcomes included increases in confidence, facilitation and presentation skills, clarity on career direction, and peer support. Participants highlighted the face-to-face workshop and mentor matching as strengths. A draft induction checklist has been prepared, incorporating the DPI human resources requirements and expanding to include requirements specific for a grazing extension role. Two online resources have been developed as part of the induction process. A Grazing Extension eGuide has been based on a spreadsheet drafted by senior extension officers outlining the key technical skills staff need. The eGuide assists staff to develop a professional development plan and provides access to online resources. DPI extension staff co-developed, with the RWQ funded Engagement and Capacity Building project and the University of Melbourne, an Introduction to Extension eLearning module for the wider audience of agricultural extension practitioners. These tools provide consistent, evidence-based guidance for new and existing officers, ensuring programs are delivered effectively and efficiently.

## Conclusion

These initiatives fast-track professional development and safeguard the long-term capability and impact of the grazing extension workforce. Embedding these programs, aligned with the Extension Model of Practice and DPI’s Grazing Extension Practice framework, enhances professional identity, supports career progression, and strengthens the delivery of triple bottom line outcomes for Queensland's livestock industry.

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<sup>B</sup> Corresponding author: [megan.willis@dpi.qld.gov.au](mailto:megan.willis@dpi.qld.gov.au)

# Novel animal welfare assessment tools for livestock euthanasia

Ben Allen<sup>A,B,C</sup>

<sup>A</sup> Ecosure Pty Ltd, Brisbane, Qld 4006; <sup>B</sup> Nelson Mandela University, Gqeberha 6001, South Africa

## Introduction

Increased societal interest in the ethics and welfare of euthanasia is driving practice changes across multiple sectors, particularly intensive livestock production, which is increasingly prone to emergency animal disease (EAD) outbreaks. Mass euthanasia during EAD responses can produce substantial pain, suffering, and death to large numbers of animals. Current approaches to welfare assessments of different mass euthanasia tools and strategies can overlook several known welfare issues. A greater understanding of the animal welfare costs, benefits and trade-offs associated with EAD response measures is required before harm to animals can be confidently reduced or ideally avoided.

## Methods

We recently adapted tools used widely in vertebrate pest control contexts to develop a novel animal welfare assessment tool for evaluating euthanasia options for pork and poultry, specifically incorporating features that address the unique challenges associated with EAD outbreaks in intensive livestock production contexts. This resulted in a novel humaneness assessment tool that evaluates animal welfare impacts for diseased and healthy animals. This is applied at individual and group scales across three stages (setup and preparation, animal handling, and mode of death) which each consider the duration and frequency of harm across all five domains. We report the results of these assessments as an illustration of what might be repeated for intensive beef operations.

## Results

All euthanasia methods cause some level of harm. A variety of welfare trade-offs also exist; reducing harm in some areas increases harm in others. The tool enables identification of specific factors driving the observed overall humaneness score.



Fig 1. Example outputs of the animal welfare assessment tool.

## Discussion and conclusion

The assessment tool increases our ability to determine the most humane euthanasia methods for use during an EAD outbreak, and for planning appropriate EAD responses. This has application for beef cattle systems if an EAD event occurs. When used in the way intended, the humaneness assessment tool will assist managers with identifying the most humane euthanasia methods that meet business, government, industry and societal welfare objectives associated with a significant biosecurity risk and an EAD response.

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<sup>C</sup> Corresponding author: ballen@ecosure.com.au

# Impact of long-distance transport on cross-bred *Bos indicus* beef cows

Michele Tree<sup>A,D</sup>, Emma J. Dunston-Clarke<sup>B</sup>, Rachel O'Reilly<sup>A</sup>, Anne L. Barnes, Ebony Schoonens<sup>A</sup>, Liselotte Pannier<sup>A</sup>, Teresa Collins<sup>A</sup>

<sup>A</sup> School of Veterinary Medicine, College of Environmental and Life Sciences, Food Futures Institute, Murdoch University, Murdoch, WA, Australia; <sup>B</sup> School of Agricultural Sciences, College of Environmental and Life Sciences, Food Futures Institute, Murdoch University, Murdoch, WA, Australia

## Introduction

Long-distance transport is routine but potentially stressful particularly for rangeland cattle due to environmental and physiological stressors during transit (Fisher et al., 2010; Stockman et al., 2011; Tarrant et al., 1992). This study aimed to examine the thermal and physiological responses of *Bos indicus* beef cows during commercial long-distance road transport in Western Australia.

## Methods

Seven trials were conducted using commercial practice and national guidelines; each journey covered 2,427 km over four days. Continuous rumen logger temperatures were recorded for 131 *Bos indicus* cows ( $\geq 343.0$  kg, condition score  $>2.5$ ), while kestrel loggers recorded truck and yard wet bulb temperature (WBT).

## Results

There were significant increases in the rumen temperature observed during loading and unloading phases. The rumen temperature dropped significantly during off-truck rest, reaching as low as 35.8°C. Adjusted rumen temperature ( $T_{AR}$ ) modelling confirmed a significant 0.82°C (95% CI: -1.12 to -0.53;  $p < 0.001$ ) drop during off-truck rest compared to when cattle were at Holding Yards prior to transport. WBT fluctuated widely with daytime highs exceeding 21°C and night-time lows dropping below 0°C. Deck-specific differences in WBT were observed. Although WBT had limited overall effect on  $T_{AR}$ , a significant association was identified during the off-truck rest period, with a 0.03°C increase in rumen temperature per 1°C rise in WBT (95% CI: 0.01 to 0.06;  $p = 0.005$ ).

## Discussion and conclusion

The study confirmed that *Bos indicus* cows generally maintain thermal homeostasis during extended transport. The WBT data suggests that deck position contributes to variability in thermal exposure, warranting further investigation into truck design and animal placement. Although WBT had limited direct influence on rumen temperature overall, its effects during rest periods suggest that even minor climatic variations can impact physiological recovery. Given the presence of pregnant animals and individual variability in thermal exposure, transport protocols should incorporate improved vehicle design, strategic animal placement, and regular rest breaks.

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<sup>D</sup> Corresponding author: Michele.Tree@murdoch.edu.au

# Livestock refuge mounds in northwest Queensland

Harriet Dunne <sup>A,D</sup>, Bob Shepherd <sup>B</sup>, Justin Hughes <sup>C</sup>

<sup>A</sup> Department of Primary Industries, Cloncurry 4824; <sup>B</sup> Department of Primary Industries, Charters Towers 4820; <sup>C</sup> CSIRO, Canberra 2600

## Introduction

Livestock refuge mounds are important disaster management structures that supply higher ground for flood threatened animals, enabling their survival of inundation events on flood-prone country. A preliminary economic analysis by the CSIRO established the viability of refuge mounds, especially when used in conjunction with good management practices such as destocking over the wet season and using dry stock in flood prone paddocks.

## Methods

Field assessments were undertaken by the DPI and CSIRO in July 2025 to quantify the physical measurements, pasture establishment, erosion and stability of existing refuge mounds in northwest Queensland (n=4). Carrying capacity of the mounds was calculated at 9m<sup>2</sup> per adult equivalent, based on accepted feedlot stocking densities.

## Results

Table 1 reports the physical mound specification data. Pasture cover was denser (data not shown) and dominated by perennial grasses where wet-season supplements were fed on top of the mounds. This practice attracted cattle, providing organic matter and nutrients that promoted vigorous pasture growth. Areas without this activity or topsoil coverage showed poorer, more variable pasture cover. Minor erosion occurred on topsoiled batters, while steeper batters without topsoil eroded severely.

**Table 1. Flood refuge mounds specifications.**

	Rectangular Mound (with a rounded upstream end)	Circular Mound
Top length (m)	200	120 (base diameter)
Top width	65	75 (top diameter)
Height (m)	1.6	1.8
Batter slopes (V:H)	1:14 (upstream end) 1:6 (sides)	1:12 (average) 1:4 (towards the base)
Crowned top	1.0% slope from centre Settlement left a flat top	2.0% slope from centre Settlement left a flat centre on mound
Top area (m <sup>2</sup> )	7,000m <sup>2</sup> (carrying 780 AE)	4,400m <sup>2</sup> (carrying 490 AE)

## Discussion and conclusion

Findings confirmed that the establishment of a dense pasture cover significantly reduces erosion on mounds. Mounds with gentler batters (1:6 or flatter) showed greater stability. The use of a sheep's foot roller to maximise compaction reduces the maintenance requirements. Supplementary feeding helps familiarise cattle with mound use and location and creates a bio-blanket to support a dense pasture cover. Although circular mounds are more soil-efficient per AE, they exhibited greater erosion where batter and crown slopes exceeded design limits—attributable to construction practices rather than mound shape. Soil type is also a consideration, as dispersive subsoils are far more prone to erosion and slumping when wet. Overall, both designs had good features that would assist livestock in escaping flood waters. However, there are several additional features and changes in construction methods that would allow the mounds to perform to a higher standard and reduce maintenance costs.

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<sup>D</sup> Corresponding author: harriet.dunne@dpi.qld.gov.au

# Evaluation of post-dehorning wound treatments in extensive Australian beef systems to improve performance and wound healing

Ethan Ryan <sup>AD</sup>, Sabrina Lomax <sup>B</sup>, Samantha Rudd <sup>C</sup>

<sup>A,C</sup> Sydney School of Veterinary Science, The University of Sydney, Camden NSW; <sup>B</sup> School of Life and Environmental Sciences, The University of Sydney, Camden NSW

## Introduction

In extensive Northern Australian cattle systems, horned calves pose significant welfare and economic challenges, including increased injury risk, carcass damage, and reduced market value (Algra *et al.*, 2023). With nearly 40% of producers still dehorning calves, and limited evidence-based wound management strategies available, this study aimed to evaluate the effectiveness of three post-operative treatments (MLA, 2023): Aluspray (AL), Tri-Solfen (TS), and a combination of both (CB), in reducing bleeding and improving wound healing and performance outcomes.

## Methods

A total of 475 weaned calves (heifers, steers, and mickeys) were allocated into 4 treatment groups: polled control (PC), AL, TS, and CB. Calves were dehorned using knives, cups, or tippers depending on horn morphology. All received oral meloxicam prior to the procedure. Bleeding scores (0–4+) were recorded immediately and on days 3–4 post-dehorning. Average daily gain (kg) and wound healing was assessed 6 weeks later using a visual scale (1–3+). Statistical analyses were conducted using ordinal logistic regression and linear models in RStudio.

## Results

No treatment significantly improved wound healing or calf performance over 6 weeks. Combination treatment increased immediate bleeding compared to Aluspray and Tri-Solfen ( $p < 0.05$ ). Heifers had higher immediate bleeding scores than steers and mickeys ( $p < 0.001$ ). Scurred calves bled less than dehorned calves ( $p < 0.001$ ), while tipped calves bled more ( $p = 0.005$ ). Horn diameter was positively associated with bleeding severity ( $p < 0.001$ ). Dry bleeding was lower in tipped calves compared to dehorned calves ( $p = 0.005$ ). After 6 weeks, wound healing scores were better in scurred calves than horned calves ( $p = 0.01$ ), and larger horn diameters predicted poorer healing ( $p = 0.003$ ). Average daily gain was influenced by initial weight ( $p = 0.03$ ) and sex  $\times$  class interaction ( $p < 0.05$ ), with polled steers gaining more than polled heifers ( $p = 0.02$ ).

## Discussion and conclusion

Topical treatments had no effect on wound healing or calf performance. The combination of Aluspray and Tri-Solfen resulted in greater bleeding compared to single treatments, indicating no benefit from layering products. Heifers bled more than steers and mickeys, likely due to management factors such as being processed immediately after drafting and on a hotter day. These findings highlight the need for improved protocols before and during dehorning, including better scheduling, handling, and rest periods. Refining dehorning techniques and selecting tools based on horn type and size are critical to minimise trauma and improve recovery. Further research into wound characteristics, particularly scurred and tipped wounds, is essential given their prevalence and impact. There is also a clear need for more effective topical treatments, as current products did not improve healing or performance outcomes.

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<sup>D</sup> Corresponding author: eryl6879@uni.sydney.edu.au

# Evaluating novel and existing wound treatments for amputation dehorning wounds in cattle

Samantha Rudd<sup>A,C</sup>, Sabrina Lomax<sup>B</sup>, Peter White<sup>A</sup>, Dominique Van der Saag<sup>A</sup>

<sup>A</sup> Sydney School of Veterinary Science, The University of Sydney, Camden NSW, <sup>B</sup> School of Life and Environmental Sciences, The University of Sydney, Camden NSW

## Introduction

Numerous pain relief products exist for dehorning cattle, but these products have limited to no effect on haemorrhage and infection, which are thought to be the 2 major causes of mortality and morbidity following the procedure (Fordyce et al., 2018). Various products including aluminium-based aerosols, pine-oil tar, and topical anaesthetics have been anecdotally used by producers to improve the welfare and production outcomes following dehorning, yet little data has been collected regarding the effectiveness of these products. This study evaluated the efficacy of commonly used topical treatments in reducing post-dehorning haemorrhage, infection, and related morbidity under commercial conditions. Additionally, this study tested the application and efficacy of two novel wound treatments (PCL patch and hydrogel disc) against these existing products.

## Methods

Sixty horned *Bos taurus* calves (130-176kg) were allocated to 1 of 6 treatment groups: PCL patch (PCL), hydrogel (HG), Aluspray<sup>®</sup> (AL), Tri-Solfen (TS), Stockholm tar (ST), or Vetigel (VG), with the same treatment applied to both horns. All statistical analysis was done using RStudio 2025.09.0 (Posit<sup>®</sup>, Boston, MA, USA). Ease of application and strength of adherence of the wound treatments, bleeding intensity and wound healing were scored and analysed using ordinal logistic regression using. Frontal sinus status (opened or closed) and instances of infection at 7 days post-operation were analysed using a generalised linear mixed model.

## Results

The application and adherence of the PCL patch, hydrogel, Stockholm tar and Tri-Solfen was poor, with Stockholm tar and Vetigel appearing to wash off immediately. Aluspray was very easy to apply and appeared to form a film over the base of the wound which often remained in place at 7 days post-operation. Wounds with open sinuses were significantly more likely to become infected ( $P = 0.004$ ), bleed more intensely ( $P = 0.02$ ), and heal slower ( $P = 0.02$ ). There was no significant difference in bleeding or infection between treatments. Descriptively, bleeding scores were lowest in Aluspray and PCL treated wounds, while PCL treated wounds had the highest incidence of infection, with 1 wound being flyblown.

## Discussion and conclusion

This study was integral for the development of the novel wound treatments, highlighting their shortcomings. While there was no significant effect of wound treatments on bleeding, infection and healing, Aluspray was identified as a potentially effective treatment due to its superior application and adherence, and lower bleeding scores. Due to the limited statistical power of the study, further research is required to determine the true impact of this treatment. The study clarified relationships between various management and wound factors, to develop or identify protocols or treatments to improve welfare and production outcomes following amputation dehorning.

This project was funded by Meat & Livestock Australia Donor Company.

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<sup>C</sup> Corresponding author: samantha.rudd@sydney.edu.au

# Attitudes and practice on pain relief for dehorning cattle in Northern Australia

*Samantha Rudd<sup>A,C</sup>, Sabrina Lomax<sup>B</sup>, Peter White<sup>A</sup> and Dominique Van der Saag<sup>A</sup>*

<sup>A</sup> Sydney School of Veterinary Science, The University of Sydney, Camden NSW, <sup>B</sup> School of Life and Environmental Sciences, The University of Sydney, Camden NSW

## Introduction

The use of pain relief is mandated by the Australian Animal Welfare Standards and Guidelines for Cattle (endorsed 2016). The 2024 Australian Beef Sustainability Framework Annual Update reported 55% of producers who perform dehorning use pain relief, however, the size and intensity of enterprises in Australia can vary greatly, indicating that this figure is not an accurate representation of the Northern Australian beef industry (Sloane & Walker, 2024). Understanding management practices, and the attitudes and considerations around the use of pain relief in beef cattle enterprises is critical for providing producers with tools to ensure best animal welfare for dehorning. This project is MLA-DC funded.

## Methods

An online survey targeting Australian cattle producers was conducted between February and August 2023, collecting data on dehorning practices, pain relief usage, and influencing factors. Additionally, four online workshops were held with Northern Australian producers and stakeholders to explore attitudes and preferences regarding pain relief and ideal wound treatments.

## Results

Fifty-four complete surveys were recorded, with 74% from Northern Australia. 92.5% of Northern Australian producers reported performing surgical dehorning, with 92% of producers dehorning calves under the age of 6 months. 77.5% of Northern Australian producers used pain relief, with Tri-Solfen<sup>®</sup> being the most commonly used pain relief product in Northern Australia (65%). The perceived benefits of pain relief were reduced pain (92.5%), improved healing (77.5%) and improved performance (62.5%). Effectiveness, cost, and practicality were the most influential factors for pain relief usage decisions ( $P < 0.001$ ). Workshop participants highlighted anecdotal benefits of pain relief, including reduced abnormal behaviour and improved recovery, yet indicated uptake was limited due to cost, access, and lack of perceived benefit.

## Discussion and conclusion

Despite legislative and industry efforts to promote pain relief, its adoption in Northern Australia remains inconsistent. Producers require evidence of production benefits to justify use, and practical limitations hinder implementation. The study identifies a need for a novel wound treatment that is effective, easy to apply, cost-efficient, and suitable for extensive systems. Such a product could reduce morbidity and mortality associated with dehorning and improve welfare outcomes.

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<sup>C</sup> Corresponding author: [samantha.rudd@sydney.edu.au](mailto:samantha.rudd@sydney.edu.au)

# Influence of heat tolerance classification on rumen temperature regulation

Angela M. Lees<sup>A,C</sup>, Pippa J. Pryor<sup>A</sup>, Runze Li<sup>A</sup>, Kieren McCosker<sup>B</sup>, John B. Gaughan<sup>A</sup>

<sup>A</sup> The University of Queensland, School of Agriculture and Food Sustainability, Gatton 4343; <sup>B</sup> The University of Queensland, Queensland Alliance for Agriculture and Food Innovation, Centre for Animal Science, Gatton 4343

## Introduction

Identifying heat tolerant cattle is an important consideration for supporting resilient animals under future climate scenarios (IPCC, 2023). The Iberia Heat Tolerance Test is used to classify the heat tolerance ability of cattle (Rhoad, 1944). Recently, Pryor et al., (unpublished) applied this methodology to classify the heat tolerance of 31 Droughtmaster cows. The objective of this study was to evaluate the rumen temperature profiles of these heat tolerance classifications over a 6-week period during a South-East Queensland summer.

## Methods

This study utilised data available from previous studies undertaken with Droughtmaster cows ( $n = 31$ ) from The University of Queensland's grazing beef teaching and research facility 'Darbalara' (27.59° S, 152.38° E), located near Gatton, Queensland, Australia. The study was undertaken with the approval of The University of Queensland animal ethics committee (2023/AE000312). Data presented herein describes data collected over a 6-week period between 1/11/2023 and 15/12/2023. Cows were classified into three heat tolerance categories, 1) Tolerant, 2) Neutral and 3) Susceptible, based on rumen temperatures collected over 9 days where ambient temperature was  $>30$  °C (Pryor et al., unpublished). A mixed effects model with a first order autocorrelation structure was used to assess rumen temperature between the heat tolerance classifications and considered date and heat tolerance classification as fixed effects and individual cow ID as the random effect. Results are presented as estimated marginal means ( $\pm$  SEM).

## Results

Variation in rumen temperature regulation was evident across the 3 heat tolerance classifications ( $P \leq 0.0001$ ). On average, Susceptible cows had the highest rumen temperatures ( $39.47 \pm 0.04$  °C), which were  $0.15 \pm 0.04$  °C and  $0.27 \pm 0.05$  °C higher than those of Neutral ( $39.32 \pm 0.02$  °C;  $P = 0.004$ ) and Tolerant ( $39.20 \pm 0.04$  °C;  $P \leq 0.001$ ) cows, respectively. Furthermore, cows classified as Tolerant, maintained rumen temperatures that were on average  $0.12 \pm 0.04$  °C lower than Neutral cows ( $P = 0.017$ ).

## Discussion and conclusion

This study demonstrated that rumen temperature regulation differed for Droughtmaster cows that were classified as Susceptible, Neutral or Tolerant. These findings indicate inherent heat tolerance variability within breed exists and provides the foundations for describing a heat tolerance phenotype. Identification of this phenotype could support the identification of genetic markers associated with thermoregulatory abilities and selection of climate resilient cattle. Further research across a range of climatic conditions and breed types is required to further explore this area.

## References

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<sup>C</sup> Corresponding author: a.lees@uq.edu.au

# Thriving through change: Integrating climate science into livestock thermal stress management in Northern Australia

Vicki Mayne<sup>A,D</sup>, John Gaughan<sup>B</sup>, Angela Lees<sup>B</sup>, Andrew Marshall<sup>A,C</sup>, Kieren McCosker<sup>B</sup>, Tim Cowan<sup>A,C</sup>

<sup>A</sup> University of Southern Queensland, Northern Australia Climate Program, Toowoomba, 4350; <sup>B</sup> The University of Queensland, Animal Science Group, Gatton, 4343; <sup>C</sup> Bureau of Meteorology, Melbourne, 3008

## Introduction

The Northern Australia Climate Program (NACP) translates climate research into practical tools to improve the capacity of the red meat industry in a variable climate. A key focus of NACP is sustainable livestock performance in variable climates.

## Research and development

Research by Cowan et al., (2024) found Northern Australian cattle herds frequently face elevated thermal loads. Analysis of seven cattle mortality events identified key triggers that contribute to thermal stress including high relative humidity, low wind speed and solar radiation. This led to the development of the Accumulated Heat Load (AHLU) forecast tool. AHLU quantifies cumulative thermal burden when the Heat Load Index exceeds breed-specific thresholds.

AHLU categorises risk (Moderate: 21–50, High: 51–100, Extreme: >100) and offers producers a proactive tool to reduce mortality risk. This is the first breed-specific thermal stress forecast integrated into an extension framework that is relevant for northern grazing systems.

## Extension and adoption

To support AHLU adoption, NACP developed a targeted education package delivered through a four-part webinar series, *Thriving Through Change: Manage Livestock Thermal Stress Before It Costs You*, featuring experts from the University of Queensland, University of Southern Queensland, and Feedworks. Topics included drivers of AHLU, thermoregulation, animal health, genetic strategies for herd resilience, and practical strategies for Northern Australia grazing systems. The series attracted 144 registrations from across Northern Australia, North America, and Indonesia, highlighting the global relevance of livestock thermal stress.

Strong engagement throughout the webinars reflected in over twenty in-depth questions, identified production challenges, and demonstrated a clear need for further research into the direct impacts of thermal stress on grazing operations. Feedback was consistently positive with comments varying from knowledge gained, relevance, and delivery. Participants commented positively on the expertise of the presenters and the relevance of the series to northern grazing systems. One family-owned grazing operation with an integrated feedlot has added the webinar recordings to their staff training folder to build internal knowledge, demonstrating practical uptake and value (pers. comm., 2025). Polling captured management strategies that producers may adopt in the future.

## Conclusion

Strong producer engagement throughout the learning series highlights the demand for evidence-based climate strategies to support livestock welfare and productivity in Northern Australia's red meat industry. The integration of targeted research combined with practical extension demonstrates how decision-support tools, like the AHLU forecast, enables proactive management under highly variable and extreme conditions. This work lays the foundation for climate-resilient livestock systems and highlights the critical role of integrated research and extension in building producer capacity and safeguarding Northern Australia's red meat industry.

## References

Cowan et al., (2024) J. Appl. Meteor. Climatol., 63, 645–663, <https://doi.org/10.1175/JAMC-D-23-0082.1>

<sup>D</sup> Corresponding author: vicki.mayne@unisq.edu.au

# Is there a return on cattle welfare investment?

Jill Fernandes <sup>A, B, D</sup>, Johann Schröder <sup>C</sup>

<sup>A</sup> Animal Centric, Brisbane, QLD 4007; <sup>B</sup> School of Veterinary Science, The University of Queensland, Gatton, QLD 4343; <sup>C</sup> Gemini R&D Services, Bilambil Heights, NSW 2486

## Introduction

Beef cattle producers in Northern Australia invest in infrastructure and husbandry to ensure the welfare of their cattle: higher-quality nutrition, low-stress handling, pain mitigation, etc. Many of these interventions are supported by published results of experimental investigations or findings from abroad. But how can producers pre-judge and prioritise the cost-effectiveness of these investments for their unique contexts? And after investments have been made, how will producers know if the changes they've made are really achieving the desired effect on the welfare of their cattle?

## Welfare assessment using animal-based evidence

A participatory and evidence-based approach to prioritising corporate investments in animal welfare was implemented in the zoo, aquarium, and equine sectors. The approach involved teaching animal caregivers at zoos, aquariums, and horse farms to assess the welfare of the animals under their care using a set of species-appropriate welfare indicators and context-adapted criteria based on the Five Domains Model of animal welfare assessment (Mellor *et al.*, 2020). The animal caregivers were guided in the use of animal-based measures that they had observed (e.g. body condition, lameness, slipping and falling, willingness to approach) to score whether the animals were having positive or negative mental experiences in each aspect of the animals' lives. Where welfare was not fully positive, specific improvements were suggested by the animal caregivers and were recorded and prioritised by welfare score. This gave each organisation a comprehensive, numerical blueprint to guide welfare investment priorities. The organisations who implemented this approach continue to carry out facility-wide animal welfare assessments every 1-3 years. They reported the system helped them to make more evidence-based decisions about capital spending, inform day-to-day management of the animals, and communicate transparently with their stakeholders about their animal welfare monitoring and continuous improvement.

## Implications for northern beef cattle producers

The authors are seeking collaboration with north Australian beef cattle producers to trial adaptation of this approach to their contexts and operational requirements for animal welfare management. Several positive welfare indicators in cattle have been suggested in the scientific literature (Keeling *et al.*, 2021). These indicators should be tested within a north Australian producer-driven cattle welfare assessment and monitoring system to determine their practical value. The approach to animal welfare improvement described by the authors moves away from knee-jerk decisions driven by sector trends and consumer perceptions, and towards an evidence-based system for guiding investments in welfare and verifying whether welfare is improving according to animal-based measures (Grandin 2022). Having such a system in place could make more effective use of producers' in-depth knowledge about the cattle under their care and could allow for more efficient and scientifically grounded allocation of resources, ensuring substantiated improvements in the welfare of cattle over time.

## References

- Mellor *et al.*, (2020). *Animals*, 10(10), 1870.  
Keeling *et al.*, (2021). *Frontiers in Animal Science*, 2, 753080.  
Grandin (2022). *Animals*, 12(20), 2831.

<sup>D</sup> Corresponding author: [jill@animal-centric.com](mailto:jill@animal-centric.com)

# Unravelling the reproductive, hormonal and metabolic differences between *Bos indicus* and *Bos taurus* cows while under nutritional restriction

Vitor R.G. Mercadante<sup>AD</sup>, Damon Smith<sup>B</sup>, Ky G. Pohler<sup>B</sup>, Cliff Lamb<sup>C</sup>

<sup>A</sup> School of Agriculture and Food Sustainability, University of Queensland, Gatton 4343, QLD, Australia; <sup>B</sup> Department of Animal Science, Texas A&M University, College Station, Texas, USA; <sup>C</sup> Texas A&M AgriLife Research, Texas A&M University, College Station, Texas, USA

## Introduction

Most of the cow-calf beef production located in tropical and sub-tropical climates utilise *Bos indicus* genetics to limit the impacts of heat stress, parasites, and low forage quality on reproductive efficiency and resulting calf production. Recent findings from our research group indicate that *Bos indicus* cattle have improved embryonic survival under nutritional restriction when compared to *Bos taurus* cattle (Fontes et al., 2017) and warranted a deeper exploration of the physiological differences between these two subspecies of cattle.

## Methods

Angus (AN; *Bos taurus*), Brangus (BR; *Bos indicus*-influenced), and Brahman (BH; *Bos indicus*) cows were randomly assigned (day -30) to either a 100% maintenance diet (MAIN; n = 22), or a 70% maintenance diet (RES; n = 23) for 45 days. Blood was collected to determine concentrations of progesterone, blood urea nitrogen (BUN), non-esterified fatty acids (NEFA), beta-hydroxy butyrate (BHBA), glucose, insulin, and IGF-1. Cows were enrolled in an oestrous synchronization protocol and ultrasonography was performed to determine ovulatory follicle and corpus luteum (CL) size. Uterine flush was performed post-ovulation and metabolomic analyses were completed.

## Results

Weight change was different between MAIN and RES cows after day -30 ( $P < 0.01$ ), demonstrating an effective dietary treatment among breeds. Breed, but not diet, influenced concentration of several hormones and metabolites, with BH cows presenting greater ( $P < 0.01$ ) insulin, BHBA, and IGF-1. Angus cows had greater ( $P < 0.01$ ) NEFA concentration than BH, while similar to BR cows. Interestingly, diameter of the ovulatory follicle and subsequent CL volume was similar among breeds and dietary treatments. In addition, uterine flush metabolites differed among breeds. Brahman cows had increased ( $P < 0.05$ ) concentrations of glutamate, aspartate (better capacity to maintain energy levels) and uric acid and xanthine (increased antioxidant capacity) compared to AN cows.

## Discussion and conclusion

Our results demonstrate that: 1) BR cows have circulating concentrations of hormones more similar to AN than BH cows; 2) BH cows are better able to utilise free fatty acids as energy in the form of ketone bodies; 3) Significant differences were found in uterine flush metabolites, with increased concentration of antioxidant agents in BR cattle. Together our results indicate and pinpoint differences of *Bos taurus* and *Bos indicus* cattle on hormonal and uterine metabolites following ovulation and during early stages of pregnancy. Understanding such differences will allow for the development of strategies to enhance fertility of beef cattle and improve overall productivity and profitability of beef production systems.

## References

Fontes, P. et al. (2019). Journal of Animal Science, 97(4), 1645–1655.

<sup>D</sup> Corresponding author: v.mercadante@uq.edu.au

# Adoption: The journey that delivers industry impact

Sally Leigo<sup>B</sup>

Meat & Livestock Australia, Fortitude Valley 4006,

## Introduction

Since 2019, leaders of the northern beef industry have emphasized the need for greater investment in accelerating adoption of best management practices and technologies outlined in *Red Meat 2030*. Achieving adoption across half of Australia's land mass and 57% of the national herd (MLA 2022) is complex due to property size, limited infrastructure, financial considerations, labour availability, weather risks, producer attitudes, and a constrained extension network. Meat & Livestock Australia (MLA) has invested significantly in understanding these challenges and developing programs that accelerate adoption. In 2024–2025, MLA's Adoption Program delivered \$81.6 million in net annual benefits to producers and engaged 11,209 producers managing 7 million cattle and 140 million ha of land. This paper outlines the strategy, tactics, and insights MLA employs to deliver measurable impact to red meat producers.

## Discussion

In describing how adoption is achieved in the red meat industry, the analogy of a road trip may be the simplest. By considering adoption the destination, extension methodology is the vehicle that carries producers along the adoption journey and industry insights plan the journey and adjust the route while travelling.

In developing an adoption plan for a particular practice, gathering as many insights as possible to understand the producers who will be the future user of this practice is a key first step. In this instance sourcing information about these future users such as how many users, size of business and herd, business structure e.g. corporate, family, Aboriginal or mining corporations, production priorities, how producers like to access new information and learn and who may be the early adopters.

Building out extension activities to support producers to implement a particular practice is well established by MLA. These include:

- Awareness raising activities about the practice, including publications, field days, paddock walks and webinars.
- Training activities that improve the knowledge, skills and confidence of the producer to implement the practice, e.g., workshops, eLearning modules or masterclasses.
- Practice change activities that support the producer to incrementally implement the practice into their business while minimising the associated risks.

These three pillars form MLA's Adoption Strategy, with an additional fourth pillar that increases the capacity of livestock advisors to support producers implementing new practices. In the future, MLA looks to motivate more northern beef producers to adopt new practices, through key industry partnerships such as meat processing and animal health companies.

## References

Meat & Livestock Australia (2022) Cattle Numbers (June 2020) Australian Bureau of Statistics

<sup>B</sup> Corresponding author: sleigo@mla.com.au

# Typology of Australian beef producers and the sustainability challenges

Taylah Faulkner, Bradd Witt<sup>B</sup> and Heather Bray

School of the Environment, The University of Queensland, St Lucia, Queensland, 4072

This is a synopsis of Faulkner et al., (2025) A typology of Australian beef producers and the sustainability challenge. *The Rangeland Journal* **47**, RJ24031. <https://doi.org/10.1071/RJ24031>

## Introduction

Global market expectations, corporate sustainability reporting, consumer demand for low-impact products, and regulatory changes are influencing the beef industry. With over half of Australia's land used for grazing, producer attitudes and values are critical for achieving sustainability. Understanding producers' perceptions of this period of rapid change is essential for meaningful engagement.

## Methods

The study surveyed 367 Australian beef producers. It explored attitudes to sustainability, climate impacts, public perceptions, and values using Likert-scale questions. Full details are contained in Faulkner et al., (2025). Data were analysed with factor analysis and cluster analysis to identify producer typologies.

## Results

The study identified four types of beef producers based on views about sustainability, public support and climate impacts. The Vulnerable Majority (~40%) and OK with the Status Quo (20%) strongly believe the industry is sustainable and downplay emissions concerns. The Moderate Quarter (25%) is moderately positive but recognises climate challenges, while the Open Minority (15%) is more critical and accepts emissions impacts. Perceptions of public support varied, creating tensions that influence engagement with sustainability initiatives.

## Discussion

The analysis identified four groups of beef producers that differed in their perceptions of industry sustainability, public support, and recognition of emissions and climate impacts. The findings have implications for engagement with producers on sustainability and for the success of programs and policies designed to increase adoption of sustainable practices. There are significant tensions and misunderstandings on how producers perceive public expectations and attitudes towards their industry. It is important that these different attitudes are better understood if they are to be considered as part of strategic sustainability communication to ensure connection and shared values and encourage active engagement with evolving public and stakeholder expectations of the beef industry.

## References

Faulkner et al. (2025). *The Rangeland Journal* **47**, RJ24031. <https://doi.org/10.1071/RJ24031>

<sup>B</sup> Corresponding author: [bwitt@uq.edu.au](mailto:bwitt@uq.edu.au)

# The role of Zero Net Emissions Agriculture CRC (ZNE-Ag CRC) in translating results to adoption

*Richard Heath<sup>A</sup>*

<sup>A</sup>ZNE-Ag CRC. Building 20, Staff House Road, The University of Queensland, St Lucia, QLD 4072

## Introduction

Zero Net Emissions Agriculture CRC (ZNE-Ag CRC) is establishing a national network of 25 Producer Demonstration Sites (PDS) to accelerate the translation of emissions reduction research into on-farm practice change across Australia's major agroecological zones.

The PDS program provides the CRC's primary pathway for testing, validating, and scaling emerging technologies and management practices in commercial farming environments.

Through co-design with producers, researchers and industry partners, the program embeds research directly into operational farm systems, enabling evaluation of feasibility, cumulative benefits, and real-world impact over multiple seasons.

## Methods

A PDS is a living laboratory - an established delivery model that brings co-design and on-farm experimentation together in real Australian farming systems. Through this approach, producers and researchers jointly shape how innovations are tested, ensuring that each site reflects the practical realities, seasonal constraints, and decision-making environments of commercial agriculture.

The PDS network also acts as a proving ground for 'stacking' multiple innovations, allowing the CRC to understand how these interact at whole-farm scale and over time. This gives producers confidence that solutions are not only scientifically valid, but workable and profitable in practice.

The model is intentionally designed to be replicable: as CRC research progresses, producers outside the network will be able to follow along, access insights, and trial supported practices in their own businesses. Events, field days, and "Communities of Practice Change" at the existing hubs provide opportunities for producers, advisors and industry to engage directly with the work underway.

## Results

Progress to date includes the establishment of Phase 1 PDS pilot sites across multiple production zones, development of baseline datasets, deployment of measurement infrastructure, and commencement of site-specific research plans.

These sites are now generating early insights into baseline performance. The PDS framework is tightly aligned with CRC research programs, ensuring that project teams integrate adoption considerations and end-user engagement from design through to evaluation.

## Discussion and conclusion

The PDS model is emerging as a critical driver of adoption. By embedding research within commercial enterprises, the CRC is generating credible, accessible, and locally relevant evidence that accelerates the shift toward low-emissions agriculture.

The early progress of the pilot sites demonstrates that producers are willing to be part of the transition, engage directly with researchers, and learn from their peers.

As the network expands, it will provide an increasingly robust national platform for validating technologies, strengthening producer capability, and supporting industry-wide emissions reduction. The PDS Program is therefore not only a research testing ground, but a practical engine for change, turning innovation into adoption and adoption into measurable impact.

Those interested in participating or staying connected can follow updates through the ZNE-Ag CRC website or LinkedIn channels.

<sup>A</sup>Corresponding author: rheath@zneagcrc.com.au



## PLATINUM SPONSOR



### Meat and Livestock Australia

[www.mla.com.au](http://www.mla.com.au)

Meat & Livestock Australia (MLA) is a producer-owned organisation supporting the nation's cattle, sheep, and goat industries through marketing, research, and development. It works to boost global demand, improve productivity, and strengthen sustainability across the supply chain. MLA promotes Australian red meat as high quality and ethically produced, while investing in animal welfare, traceability, and consumer education. Through innovation and partnerships, it helps drive industry growth and uphold Australia's reputation as a global leader in red meat production.

## MAJOR CONFERENCE SPONSOR



### Consolidated Pastoral Company

[www.pastoral.com](http://www.pastoral.com)

Consolidated Pastoral Company (CPC) is a leading Australian managed, UK owned Agribusiness with strong ESG values. CPC owns and operates a portfolio of eleven station aggregations in Australia and two feedlots in Indonesia. Across more than 5.3m hectares of land, the CPC team care for more than 340,000 head of cattle, 30,000 goats, 40,000 sheep and produce a diverse range of crops. With an asset base in excess of AUD\$1 billion, CPC supplies a variety of domestic and international customers.

## GOLD SPONSOR



### Queensland Government

[www.dpi.qld.gov.au](http://www.dpi.qld.gov.au)

The Queensland Government is committed to ensuring the state's primary industries – the essential backbone of our economy and communities – remain productive, profitable and sustainable for future generations.

We support farmers and agribusinesses to improve productivity and profitability by unlocking new opportunities, managing risks, and building industry resilience. We back agriculture priorities through leading research, development and extension for agricultural innovation and productivity growth.

Our Primary Industries Prosper 2050 is our shared vision for transforming together, industry and government, that will see Queensland's primary industries thrive.

## SILVER SPONSOR



### Paraway Pastoral Company

[www.paraway.com.au](http://www.paraway.com.au)

Paraway Pastoral Company Limited owns and operates large-scale cattle and sheep enterprises across diverse production systems throughout Australia, supported by dryland and irrigated cropping. Managing over 250,000 cattle annually and 200,000 sheep across 28 pastoral businesses and more than 4.4 million hectares, Paraway focuses on productive, sustainable grazing systems and strong animal performance. We value research that delivers practical, commercially relevant outcomes for producers and the broader beef industry.

## CONFERENCE DINNER SPONSOR



### TNQ Drought Hub, Northern Hub and SQNNSW Innovation Hub

The TNQ Drought Hub, Northern Hub and SQNNSW Innovation Hub are three of the eight Drought Resilience Adoption and Innovation Hubs, funded by the Australian Government's Future Drought Fund.



Our mission is to help farmers, communities and regional agricultural industries build resilience to drought and climate variability through extension, adoption and place-based programs.



Embedded across Northern Australia, each hub is partnered with Industry and Farmer Organisations, Natural Resource Management Groups, Universities and Governments for a collaborative regional approach.

## NAME BADGE AND LANYARD SPONSOR & NABRC COUNCIL MEETING SPONSOR



### CQUniversity

[www.cqu.edu.au](http://www.cqu.edu.au)

CQUniversity's Institute for Future Farming Systems (IFFS) is a world leader in research which delivers practical solutions which are bolstering the productivity, profitability, and sustainability of the northern Australia agricultural sector.

With expertise in precision livestock, agricultural education and extension, precision horticulture, precision cropping systems, non-invasive sensors, and agricultural microbial genomics, the IFFS team is committed to working in collaboration with industry to ensure our research addresses the challenges faced by those growing our food and fibre to deliver impact for industry.

## WELCOME RECEPTION SPONSOR



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[www.lallemandanimalnutrition.com](http://www.lallemandanimalnutrition.com)

Lallemand Animal Nutrition develops and delivers high value microbial solutions that help livestock producers improve animal performance, forage quality and farm profitability. With nearly 30 years of experience in Australia, we provide proven forage inoculants, rumen specific live yeasts, microbial additives and practical on farm support. Our regionally based technical team works alongside producers, nutritionists and feed mills to ensure products perform in real world conditions.

## COFFEE CART SPONSOR



### The University of Queensland

[research.uq.edu.au](http://research.uq.edu.au)

The University of Queensland is ranked number one in Australia and sixth globally for agriculture research. UQ delivers impactful beef research that creates value across the supply chain and supports sustainable production.

The University also educates future leaders in food, agriculture, and veterinary science, with a long-standing reputation for excellence in teaching and research. Learn more about UQ's food and agriculture research [www.uq.edu.au/research/news/agribusiness](http://www.uq.edu.au/research/news/agribusiness)

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[olssons.com.au](http://olssons.com.au)

Olsson's is Australia's longest established and most innovative lick block manufacturer, operating for over 75 years. Built on generations of industry knowledge and ongoing research, Olsson's produces mineral, trace element, and protein lick blocks to support livestock health and performance year-round. From protein supplementation during the dry season to balanced mineral nutrition in all conditions, Olsson's solutions are trusted by producers across Australia.

## CONFERENCE SUPPORTERS



### CERES TAG

[cerestag.com](http://cerestag.com)

CERES TAG is the world's first direct-to-satellite livestock monitoring platform, transforming how producers manage and optimise their herds. Founded in Australia and now operating globally, CERES TAG delivers scalable, infrastructure-free insights anywhere. CERES GEN6, introduces advanced reproduction algorithms alongside proven Pasture Feed Intake, location, movement and behaviour insights. The resulting insights enable smarter productivity, biosecurity, traceability and sustainability decisions. Trusted by producers and industry organisations worldwide, CERES TAG is redefining livestock intelligence, helping drive a more efficient and sustainable future.



### Australian Country Choice

[www.accbeef.net.au](http://www.accbeef.net.au)

Australian Country Choice (ACC) is a third-generation, family-owned Queensland company and Australia's largest vertically integrated cattle and beef supply chain. Founded by the Lee family, ACC manages seedstock production, breeding, backgrounding, farming, lot-feeding, processing and product distribution. Dedicated to best practice and high-quality meat for domestic and export markets, ACC has traditionally specialised in short-fed, grain-finished beef, but is now diversifying into premium long-fed products such as Wagyu and Black Angus to meet growing demand.



### Frontier Genetics

[frontiergenetics.com.au](http://frontiergenetics.com.au)

"Beefing Up Genomics" is a pioneering partnership between Frontier Genetics and Meat & Livestock Australia (MLA) focused on optimising genetic gain in Northern Australian beef herds. By establishing a producer-led reference model across 10 BREEDPLAN recorded herds, the project utilises advanced genomics and standardised data collection for hard-to-measure traits. Our mission is to support and expand current reference population information.

The project will drive the adoption of high-quality recording for the purpose of genetic evaluation ultimately improving genetic gain in the northern beef industry, within and outside of the Frontier Genetics producer group. This will include adoption-based initiatives such as field days, as well as more targeted training exercises directed at the group directly and other producer groups.

## TRADE DISPLAY



### Agrimix

[www.agrimix.com.au](http://www.agrimix.com.au)

Agrimix is a family-owned Australian agritech helping northern beef producers turn research into paddock results and lift profitability. We combine on-farm agronomy with digital tools that improve pasture establishment, grazing performance and sustainability. Pasture Portal by Agrimix guides pasture selection using agronomic parameters, helping users make pasture decisions with better outcomes and better returns. Agrimix Flux is our measure-model-verify toolkit that quantifies soil carbon change in near-real time. Together, we help producers grow better pastures and back their claims with credible evidence.



### CSIRO

[www.csiro.au](http://www.csiro.au)

CSIRO solves some of the biggest agrifood challenges facing Australia. We work closely with the livestock industry improving productivity, profitability and sustainability through better livestock breeds and management practices. Our work spans Australia and beyond delivering impact and building new pathways and new technologies for the future. Partnering with CSIRO provides access to innovative science, technology and facilities, relevant IP and global networks across the value chain.

Learn more about our wide-ranging research and how you can partner with us:

<https://www.csiro.au/en/research/animals/livestock>



### Northern Australia Climate Program (NACP)

[nacp.org.au](http://nacp.org.au)

The Northern Australia Climate Program (NACP) delivers cutting-edge climate research, development, and extension services to help cattle producers manage climate risks and seasonal variability. Led by UniSQ with partners including BoM and MLA, NACP has developed practical tools like the Accumulated Heat Load and Cattle Comfort Index Forecasts, Drought Monitor, Flash Drought Index, and the Green Date Analysis. These resources support informed decision-making across northern Australia's red meat supply chain, with Climate Mates providing localised extension, training, and support.



### Farmbot

[farmbot.com.au](http://farmbot.com.au)

Farmbot Monitoring Solutions delivers innovative and scalable hardware-and-software solutions, empowering livestock producers through integrations of cutting edge IoT technology, and near real-time data analytics.

The ever-expanding ecosystem enables proactive, remote management of critical on-farm resources, supporting smarter and more sustainable agricultural practices. Farmbot saves time and reduces risk by ensuring issues are identified and resolved early, enhancing animal welfare and boosting productivity.

Farmbot's offering has rapidly evolved beyond water solutions to a comprehensive suite of remote monitoring, input management, and control solutions. Through the MyFarmbot software platform, users can monitor water levels, pressure, and flow rates; track diesel tank levels, on-farm weather, and security footage; assess pasture growth; and even control pumps – all from a single device.

Farmbot works to keep your property safe and your water secure. Farmbot means peace of mind.

# CONFERENCE CONTRIBUTORS



## Northern Territory Department of Agriculture and Fisheries

[daf.nt.gov.au](http://daf.nt.gov.au)

The Northern Territory Department of Agriculture and Fisheries works to grow the sector and maintain the Territory's reputation as a supplier of safe and quality agricultural produce and sustainable fisheries.

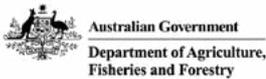
The Livestock Industries Branch undertakes RD&E projects to increase the productivity, profitability and sustainability of the NT pastoral industry. They work in the areas of beef breeder herd productivity, enterprise development, calf mortality, rangeland management, fertility/selection, nutrition/supplementation, pasture modelling as well as building industry capacity through delivery of training courses and industry events.



## Eastern Plains Angus

[www.easternplainsangus.com.au](http://www.easternplainsangus.com.au)

Eastern Plains Angus is owned by Andrew & Sally White. We run 220 stud Angus females alongside 600 commercial Angus females, west of Guyra, northern NSW. 2026 marks the 57th year of operation for our Stud which features an on-property Annual Bull Sale each August. We're proud to offer an Angus genetics program tried & tested in our own commercial herd, independently assessed for structure, temperament & fertility, backed by genomics + long term formal performance recording & genetic evaluation.



The Northern Hub, SQNSW Innovation Hub and TNQ Drought Hub receive funding from the Australian Government's Future Drought Fund



### Find us Table #1

Learn about activities & research boosting resilience across the beef industry

The three Northern Australia Drought Resilience Adoption and Innovation Hubs are helping farmers, communities and the region's agricultural industries build resilience to drought and climate variability through extension, adoption and place-based programs.

Scan to learn more about each hub:



Northern Hub



SQNSW Innovation Hub



TNQ Drought Hub



## Together we're building a profitable, productive and sustainable beef cattle industry.

The Department of Primary Industries works collaboratively with industry, research organisations and regional partners to deliver innovation, productivity growth and practical solutions that benefit producers.

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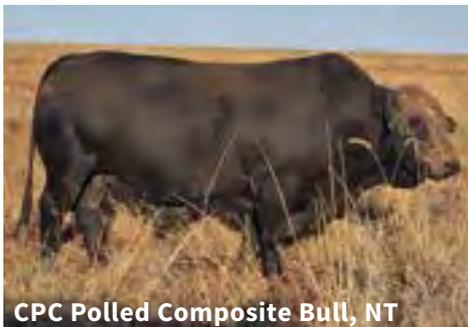
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DPI-2770 02/26

Authorised by the Queensland Government, William Street, Brisbane.



CPC Polled Composite Bull, NT



CPC Polled Boran Bull, QLD



CPC cattle in our North Indonesia Feedlot – proven tropical feedlot performance



## BRED TO BREED & FEED

CPC's composite cattle with Angus and Kenyan sourced Borans are a total outcross giving unbelievable hybrid vigour.

Highly fertile

Fast young growth

Bred to thrive in harsh conditions and perform in feedlots and on the plate

### Contact:

David Young: 0428 257 686  
[livestock@pastoral.com](mailto:livestock@pastoral.com)

The North Australia Beef Research Council thanks the following organisations for their generous support of the 2026 Northern Beef Research Update Conference.

