NORTHERN TERRITORY GOVERNMENT

DEPARTMENT OF PRIMARY INDUSTRY AND FISHERIES

PRIMARY INDUSTRIES

ANNUAL RESEARCH ACHIEVEMENTS REPORT 2013-14

March 2015

Bibliography:

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Contact:

Northern Territory Government
Department of Primary Industry and Fisheries
GPO Box 3000
Darwin NT 0801

http://www.dpif.nt.gov.au

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Contents

About this report

The 2013-14 Annual Research Achievements Report provides a summary of research and development activities in primary industries in the Northern Territory (NT) by the Department of Primary Industry and Fisheries (DPIF) excluding fisheries for which there is a separate annual report series titled Fisheries Status Reports 2013. The report covers current and recently completed research in the pastoral and biosecurity sectors. The report highlights the effort of DPIF researchers through which services are provided to primary producers to improve their productivity and profitability and to control animal and plant diseases.

Due to a recent outbreak of the cucumber green mottle mosaic virus disease in the NT, it was not possible to include reports on the plant industry sector because research officers were engaged in the control of the disease. Their contribution will be published in next year's report.

DPIF's Industry Development Plan 2013-17 focuses on profitable and productive primary industries, highlighting the following emerging challenges for research and development among others: provide certainty and security to encourage investment, facilitate continuous improvement in production quantity and quality, expand market options for Territory products, develop and promote a more efficient and environmentally sound production system, promote biosecurity and encourage Indigenous participation. Each research project in this report addresses at least one of these challenges.

Primary industry activities in the NT focus mainly on pastoral, crop and horticultural production. Products include beef cattle, buffalo, crocodiles, field crops, pasture, hay, seeds, forestry products, mangoes, melons, vegetables and cut-flowers.

The primary industry sector in the NT has significant links with other sectors of the local economy and contributes to manufacturing, transport, storage and retail, thereby enhancing employment.

Comments and suggestions for improvements of future editions of this report, including content, layout and structure, are most welcome. Please send your comments and suggestions to technical.publications@nt.gov.au.

Images/photos: Unless otherwise stated, all images and photos are sourced from the lead researcher.

Cover Images	Left: Feed trial for cattle in Katherine (Source: Kieren McCosker) Right: Inoculated wild-caught *Culicoides* with bluetongue virus serotype 1 (Source: Lorna Melville)
Report compilation:	Hassan Bajhau, Jason De Araujo, Tim Schatz and Christine Long

Glossary of abbreviations

ACIAR	Australian Centre for International Agricultural Research
AI	Artificial insemination
ASPIAC	Alice Springs Pastoral Industry Advisory Committee
AZRI	Arid Zone Research Institute
BF	Berrimah Farm
BEF	Bovine ephemeral fever
BHF	Beatrice Hill Farm
BRAC	Barkly Research Advisory Committee
BSC	Body condition score
BTV	Bluetongue virus
BVL	Berrimah Veterinary Laboratories
CDU	Charles Darwin University
CSIRO	Commonwealth Scientific Industrial Research Organisation
DDRF	Douglas Daly Research Farm
DMD	Dry matter digestibility
DPIF	Department of Primary Industry and Fisheries (NT)
EBVs	Estimated breeding values
F1	First filial generation (the generation of hybrids arising from a first cross (animal genetics))
HGPs	Hormonal growth promotants
KPIAC	Katherine Pastoral Industry Advisory Committee
KRS	Katherine Research Station
MLA	Meat and Livestock Australia
NT	Northern Territory
NTCA	NT Cattlemen's Association
OMPRS	Old Man Plains Research Station
PDS	Producer demonstration site
PD	Pregnancy diagnosis
PPMS	Precision pastoral management system
PPMT	Precision pastoral management tools
QAAFI	Queensland Alliance for Agriculture and Food Innovation
RLMS	Remote livestock management system
SOC	Soil organic carbon
SRM	Society for Rangeland Management
UNE	University of New England
VRD	Victoria River District
VRRS	Victoria River Research Station

1 Biosecurity and Product Integrity

1.1 Detection of the Bluetongue Virus and its Vectors to Enhance Surveillance

Contact: Lorna Melville – OIC Berrimah Veterinary Laboratories

Reference to the DPIF Industry Development Plan 2013-2017:

3.3.1 Maintain and improve controls for major pests and diseases to support industry development and protect the Territory's environment.

Project Status: Completed.

In a collaborative project with NSW Agriculture to develop molecular assays for the detection of *Culicoides* vectors of bluetongue virus (BTV), we inoculated wild-caught *Culicoides* with BTV serotype 1 at Berrimah Veterinary Laboratories (BVL). These inoculated insects were then used to validate assays for the detection of BTV in alcohol-fixed *Culidoides*. Assays that had been developed in NSW for the identification of specific species of *Culicoides* were trialled in field collections of *Culicoides* made in light traps.

Results

Culicoides inoculated with BTV1 were supplied to NSW.

Assays for four vector species were established at BVL and used to screen light trap collections.

Aliquots of BTV and blood samples containing BTV serotypes 1, 2, 16, 21, 20 and 23 were supplied to NSW.

Insect collections made for the National Arbovirus Monitoring Program (NAMP) were screened for the presence of BTV.

Conclusions

Assays for *Culicoides* species could detect two exotic species (*C. nudipalpis* and *C. orientalis*) and the common local vector *C. brevitarsis*.

BTV could be detected in low numbers of infected insects (1:5000).

Recommendations

Introduce molecular assays under NAMP for BTV in wild caught insects.

Inoculating *Culicoides*

Inoculated *Culicoides*

1.2 Investigating the Pathogenesis of Bovine Ephemeral Fever

Contact: Robert Barigye, Research Fellow, Berrimah Veterinary Laboratories

Reference to the DPIF Industry Development Plan 2013-2017:

3.3.1 Maintain and improve controls for major pests and diseases to support industry development and protect the Territory's environment.

Project Status: Continuing.

The research is focused on investigating the pathogenesis of bovine ephemeral fever (BEF) by defining and describing the kinetics of important cytokine networks that underlie the viraemic phase of BEF when fever and other symptoms are present. It is also intended to investigate tissue tropism of the BEF virus and the likelihood of persistence of viral nucleic acid and antigens (proteins) in peripheral sites and what implications such persistence may have on the pathogenesis and post-infection immunity. The study is using molecular technologies, such as reverse transcriptase polymerase chain reaction (qRT-PCR), for detecting the BEF virus in blood, tissues and other biological specimens including, but not limited to, synovial joint fluids, pericardial fluids, and peritoneal fluids. A polymer-based immunohistochemistry (IHC) protocol we standardised in 2012-13 is also being applied to detect and spatially localise BEF viral antigens in bovine tissues and in paraffin-embedded sections prepared from BEF virus-infected baby hamster kidney cell lines. Recently, a quantitative immune-enzymatic assay was used to test for six cytokines in plasma samples of cattle naturally infected by the BEF virus. As the tested lymphokines include three pro-inflammatory cytokines (TNF-α, IL-1β and IL-6) and one anti-inflammatory cytokine (IL-10), the research data will help determine the basis of fever and other symptoms in cattle acutely infected with the BEF virus. Also, the kinetics of two additional cytokines (IL-2 and IFN-γ) have been determined during the time infected animals were showing a virus neutralisation antibody response; that information will help us to define the basic immunological events that initiate and underlie the solid immunity seen during the post-infection period. Since the specimens are being taken from acutely infected, dead and convalescing cattle that have survived acute BEF, the results will be useful for drawing inferences on the natural course and pathogenesis of the disease. The study cattle are on cattle stations and government research farms in the NT. The specific objectives of the research are to:

- Develop and enhance skills in arbo-virology and understand vector-borne diseases in northern Australia.
- Develop advanced staining techniques, such as immunohistochemistry and *in situ* hybridisation, relevant for research and/or diagnosis of BEF.
- Investigate the relative pathogenicity of different strains of the BEF virus using case material from natural infections or experimental inoculations.
- Investigate specific immunological and inflammatory responses associated with the disease, including the involvement of particular lymphocyte populations, the role of neutrophils, prominent cytokines and other inflammatory mediators.
- Disseminate the results through relevant symposia and conferences.

Results

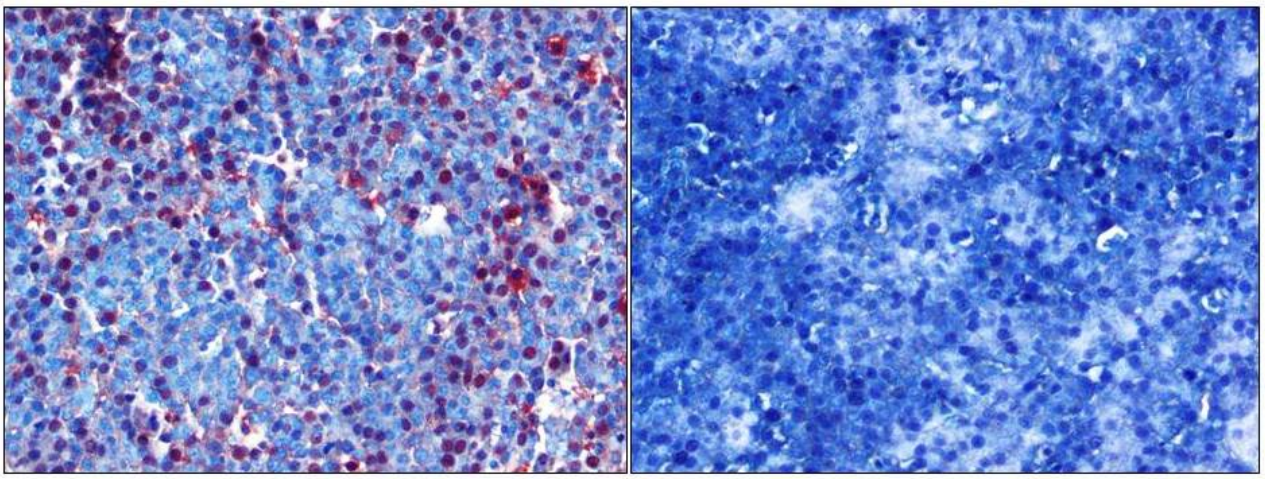
A new IHC protocol has been standardised for the detection of BEF virus antigens in bovine tissues and baby hamster kidney cell lines. The new protocol will be useful in the ongoing characterisation of the spatial organ/tissue distribution of BEF viral antigens (proteins) in histological sections derived from bovine tissues/organs. The IHC protocol is currently only used as a research tool, but could be further improved and adopted as an adjunct tool for BEF diagnosis, particularly where post-mortem tissue samples are the only biological specimens available for BEF diagnosis.

The new IHC protocol has been successfully used to demonstrate BEF viral antigens in baby hamster kidney

cell lines routinely used for culturing the BEF virus at Berrimah Veterinary Laboratories. As such, this protocol could potentially be used in the qualitative assessment of cell culture-derived immunogens for use in the elaboration of BEF vaccines or BEF virus antigen needed for use in various diagnostic assays.

In addition to what was previously known about the short-lived viraemia in BEF, qRT-PCR has shown the persistence of BEF viral nucleic acid in the spleen and haemonode of cattle up to five months post-infection. While more data is needed to corroborate these findings, it is apparent that the spleen in particular and probably the haemonode, are likely to provide a micro-environment that is crucial to sustain immunological events responsible for the long-lived immunity usually seen in animals that recover from acute BEF. Of the various tissues so far tested, the spleen and haemonode appear to be of diagnostic significance if IHC were to be adopted as an adjunct diagnostic assay.

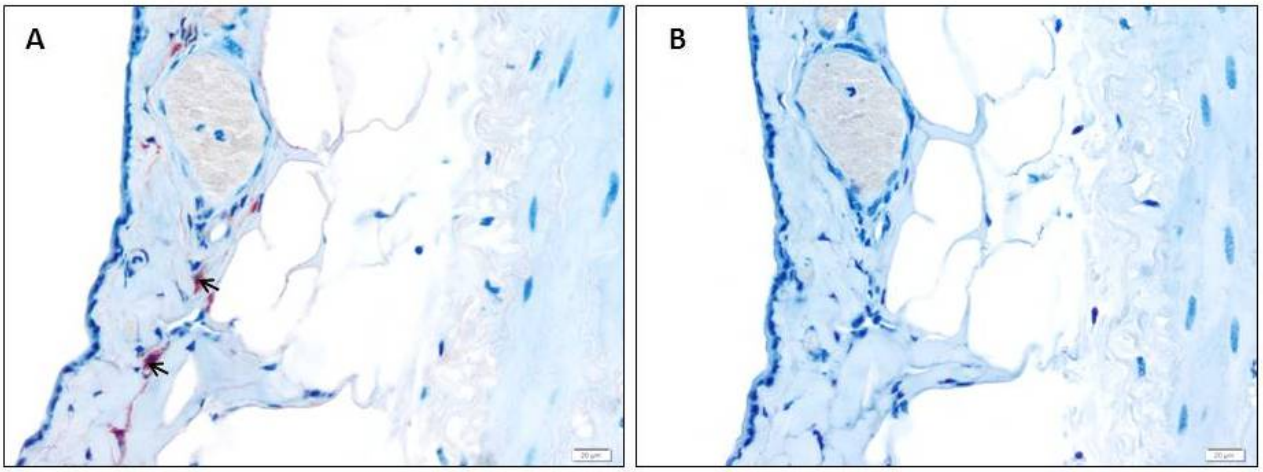
Cytokines have confirmed increased expression of IL-1β, IL-6 and TNF-α in febrile cattle acutely infected with the BEF virus. IL-1β apparently plays the most significant role in the induction of fever in BEF. In addition, the data shows that IL-10 is also elevated in infected cattle and arguably plays a modulatory role on the febrile response and may be an evolutionary strategy responsible for the transient nature of febrile symptoms during BEF virus infections. The data has also shown increased expression of IL-2 and IFN-γ prior to the virus neutralisation antibody response. Viraemia was prolonged in animals that showed the weakest IL-2 and IFN- γ responses despite sufficient virus neutralisation antibody titres.



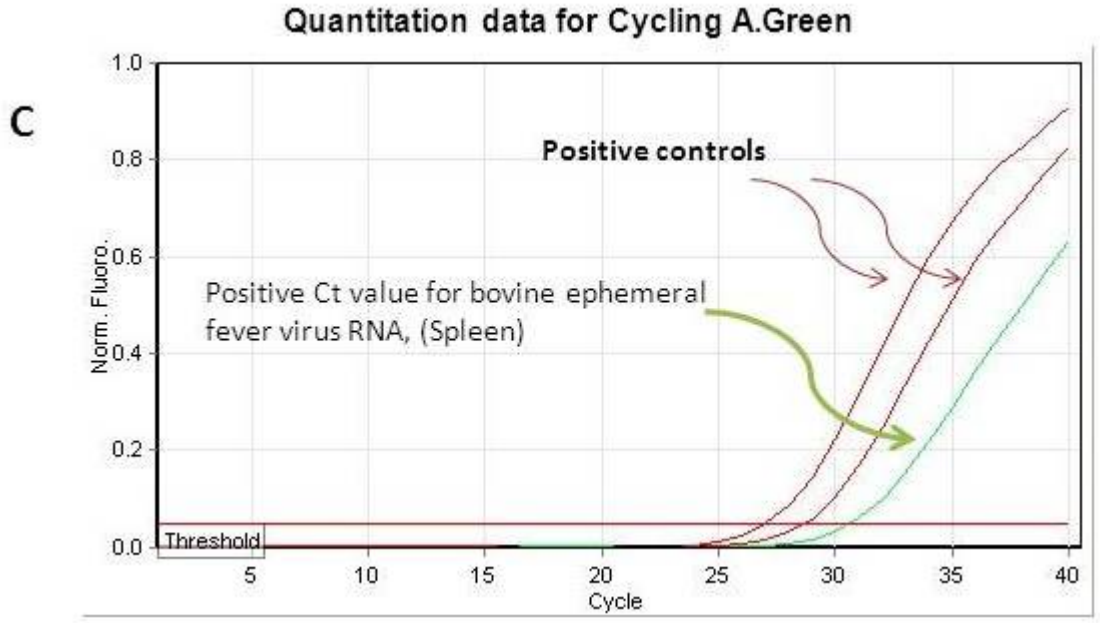
Bovine ephemeral fever virus infected baby hamster kidney (BSR) cells probed with anti-DB5 mAb @ 1:1000

Bovine ephemeral fever virus infected baby hamster (BSR) cells probed with negative mouse serum @ 1:1000

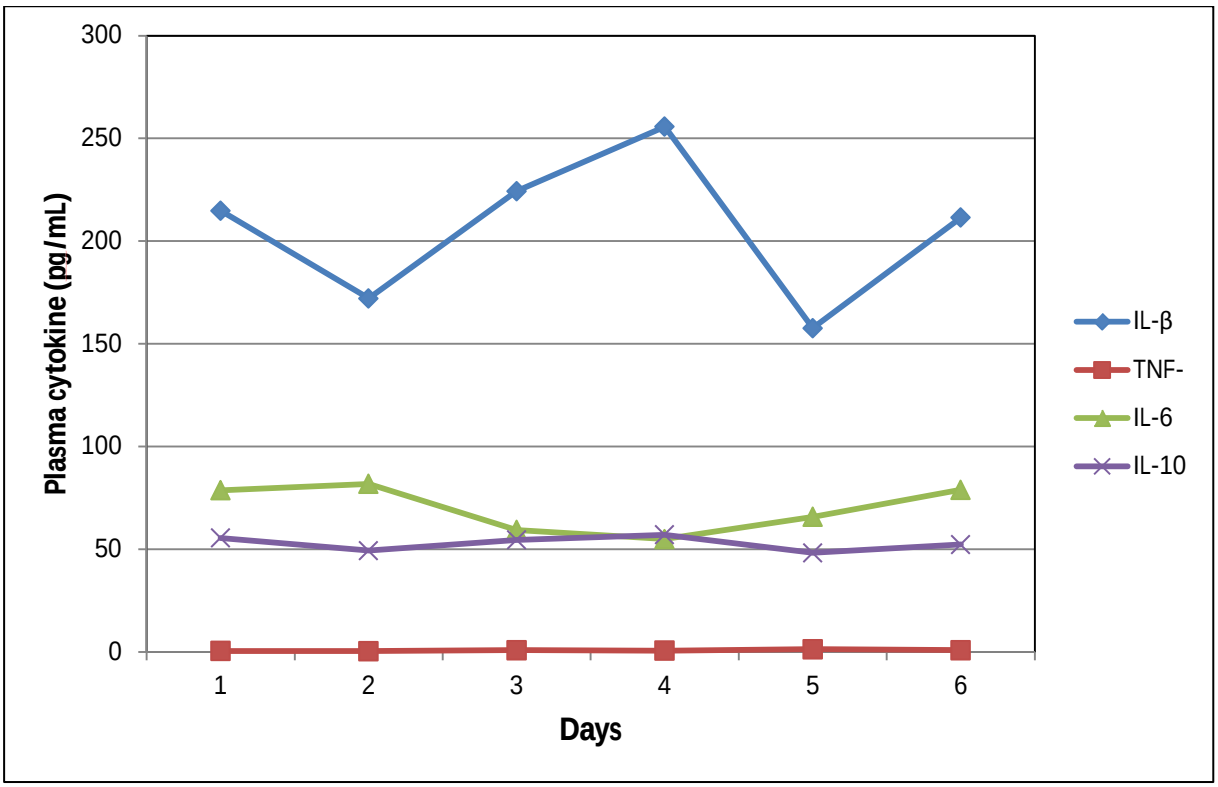
The above photomicrographs represent part of the IHC data collected during the standardisation of a new IHC protocol for use in detecting BEF virus antigens in bovine tissues and baby hamster kidney cell lines. As BEF virus-infected bovine tissues were initially not available, testing of experimentally infected baby hamster kidney cell lines was necessary to obtain some form of positive control needed for protocol optimisation. Note: BEF virus-PCR-positive splenic tissue has since been obtained for use in all future IHC assays.



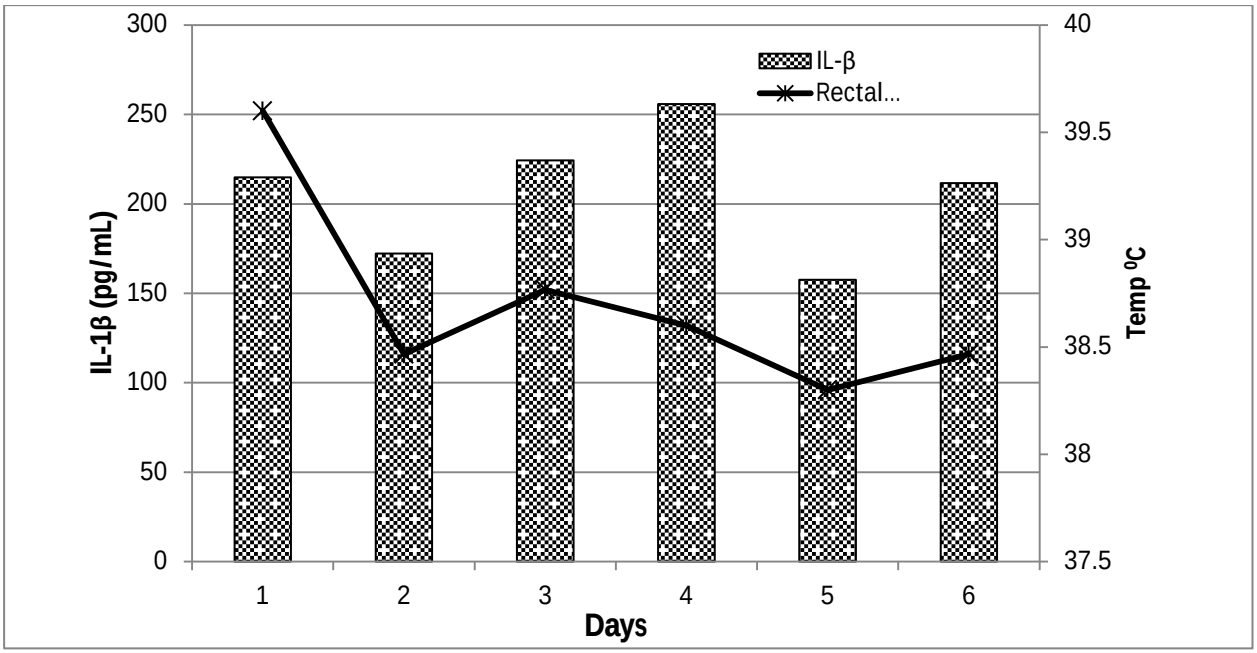
Spleen. Fig A. Intracytoplasmic bovine ephemeral fever virus antigen is seen within macrophages and within occasional spindloid shaped cells of perivascular and capsular location. A replicate section probed with negative mouse serum (Fig B) has been included for comparison.



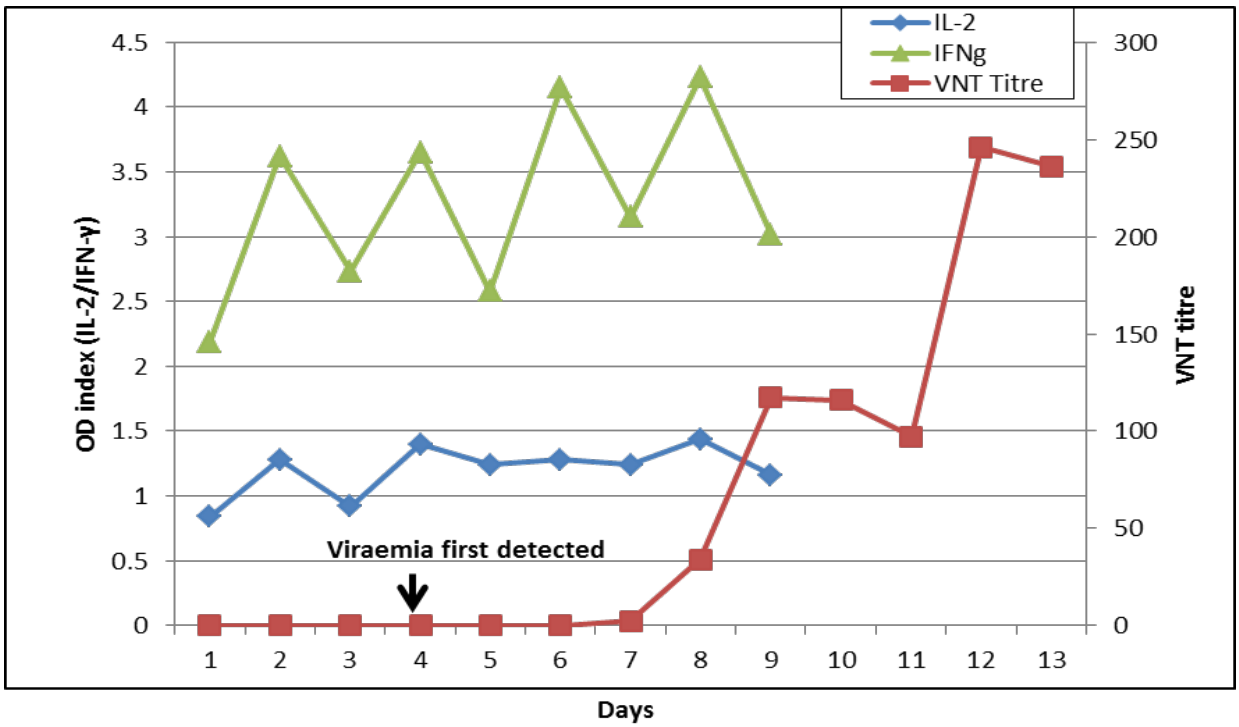
In one bull that initially survived an acute BEF infection, real time PCR test on the spleen was positive for BEF RNA three months after the acute disease. Subsequent to this finding, splenic tissue and haemonode from at least two other Brahman heifers have also tested positive for the BEF virus ribonucleic acid providing the first evidence ever that these organs might represent a site of viral persistence and/or replication. Note that in all these cases, IHC also demonstrated the presence of intracellular viral antigen within pericyte-like, macrophage-like and dendritic cell-like cells located within the capsule and paracortical areas of the lymphoid follicles.



Graph 1A. Kinetics of pro-inflammatory cytokines (TNF-α, IL-1β, IL-6) and the anti-inflammatory cytokine (IL-10) in viraemic cattle during natural BEF infections. Blood samples for studies on viraemia, virus neutralisation antibody responses and the plasma cytokines were collected from six heifers during a BEF outbreak at Berrimah Farm in October, 2013. The data indicated IL-1β is highly correlated with fever in BEF virus-infected cattle (also refer to Graph 1B) while IL-10 appears to play a modulatory role on the kinetics of the other pro-inflammatory cytokines, particularly IL-6 and TNF-α.



Graph 1B. Kinetics of IL-1β and rectal temperatures in viraemic cattle during natural BEF infections. The data indicated IL-1β is highly correlated with fever in BEF virus-infected cattle.



Graph 2. Comparative kinetics of Th1 cytokines (IL-2 and IFN-γ) and virus neutralisation antibody titres during and after viraemia in cattle naturally infected with the BEF virus. Blood samples for the studies were from eight heifers in a sentinel herd of adult Brahman cattle during a BEF outbreak at the Beatrice Hill Research Farm in October, 2012.

2 Pastoral Production

2.1 The Phosphorus Project

Contact: Tim Schatz - Principal Pastoral Production Research Officer

Reference to the DPIF Industry Development Plan 2013-2017:
1.2 Facilitate continuous improvement in production quantity and quality.
1.2.1 Targeted research, development and extension to address agreed industry priorities.

Project Status: Completed.

Despite the potential benefits of wet season phosphorus (P) supplementation, sales of P supplements across northern Australia indicate that this advice has not been widely adopted. The reasons include the difficulty of implementing P supplementation during the west season, a lack of clearly demonstrated benefits of P supplementation in breeders and a lack of a simple diagnostic test for P deficiency. This project was designed to address these issues in collaboration with the University of Queensland. It aimed to determine the response in cows and growing steers of P supplementation at different times of the year (i.e. wet season, dry season and all year round) and to find a diagnostic test for P deficiency.

Automatic drafters with walk-over-weighing technology were used to supply the supplements in the same paddock to avoid paddock effects.

Cattle being drafted by the auto drafter at the Brunchilly P trial site

Results

The final data was recorded in August 2013. The final report was submitted to Meat and Livestock Australia (MLA) and is available on the MLA website.

The faecal P:metabolisable energy (ME) ratio showed that indicator steers and breeders were deficient in P but no response to P supplementation was evident and the serum inorganic P (SIP) concentration suggested that indicator steers were not deficient in P. These results suggest that the faecal P:ME ratio is not a reliable indicator of P deficiency under extensive conditions and may require further validation across a range of land types/pasture bases before it can be recommended for wide use by the industry.

There was no response to P supplementation either in cows (reproductive rates) or in steers (live-weight gain). The performance of steers was excellent with weaning rates of approximately 85% in both groups over two years and weight gains of approximately 150 kg in supplemented and control groups over the first wet season. This suggests that P was not limiting.

The pregnancy rate in the control group of cows over an extended period without a P supplement was starting to have an effect as their pregnancy rate was 7% lower than that of the P-supplemented group. However, the difference was not statistically significant.

The faecal P:ME (and SIP) indicated an increase in P intake in supplemented cows and steers in the dry season. Offering P in the dry season resulted in a higher intake of P than when offered in the wet season. However, the carry-over effect of dry season P supplementation on breeders remains unknown.

A key outcome was the improvement in the remote livestock management system - auto drafters with a new prototype were likely to be released commercially in late 2014.

Conclusions

In general, despite the faecal P:ME ratio indicating that the diet was deficient in P, all cows, including the control group, had adequate nutrition to give good reproductive performance over the course of the trial, which followed and included above average wet seasons. There were no significant differences between treatments in any of the parameters measured.

The project confirmed previous recommendations that plasma inorganic P (PIP) is the most appropriate indicator of P intake in cattle. The project demonstrated that faecal P was related to the diet P content, but raised some issues about timing of collection, the number of samples required and the reliability of threshold values for different land types/pasture mixes. Further validation of faecal P:ME is required under a much wider range of land types, pasture mixes and across different seasonal conditions before its use can be recommended to the industry.

Recommendations

The project identified the following recommendations for future research:

Repeat the P trial conducted at Brunchilly in areas where a response to P has been previously confirmed (PIP concentration near to 1 mmol/L in growing animals at the start of the dry season) to determine if carry-over effects of dry season P supplementation of breeders is a possible strategy to build up P reserves in breeders for mobilisation in the wet season.

Further validate the faecal P:ME test under different land types, diet composition and different breeder management systems (segregated vs year-round calving mobs) and develop site-specific thresholds.

Further evaluate the relationship between dietary N, dietary P and weight gain on PIP (i.e. at what dietary N or dry matter digestibility is P no longer the first limiting nutrient), which may provide more specific guidelines for the timing of blood sample collection and the interpretation of results. The issue of site-specific threshold values for PIP could also be evaluated, possibly on existing samples.

A simplified and standardised method for collection, storage and transport of blood samples for PIP testing should be developed to overcome some of the perceived logistical issues around the technique. The use of blood spot cards, dip sticks or simple crush side tests could be explored.

The collection of faecal samples for P analysis also needs to be examined in more detail, such as the timing of sample collection and the number of samples collected and analysed. Current recommendations are for early wet season sampling, whereas the pen experiment found that the relationship between P intake and faecal P changed with time spent on a diet representative of early wet season pastures.

A detailed understanding of the gene regulation of bone response to P intake could be undertaken. Next generation sequencing of bone biopsies collected during Experiment 1 could be conducted to determine the

key differentially-expressed transcripts and gene pathways involved in a P-mediated response in bone growth. Appropriate samples are currently stored at -80° C.

The importance of soft tissue P to repletion/depletion of cattle to changes in P intake could be investigated.

Further work may be required on the effect of dry matter content of samples submitted to commercial laboratories for faecal P and NIRS analysis.

The use of soil P analysis to indicate P status of paddocks needs to be revisited and examined in conjunction with simple currently available satellite imagery. The development of remote technologies from Precision Agriculture that could be employed to assess P status on a paddock scale may be investigated.

The supplement enclosures at the Brunchilly P trial site

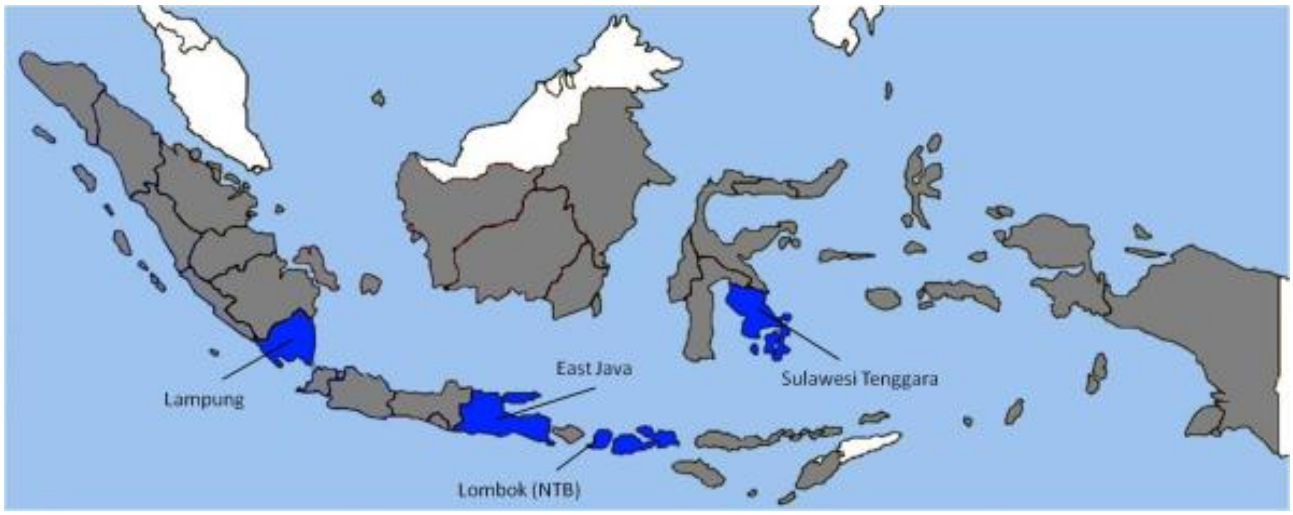
2.2 StrawCow - Improving Reproductive Performance of Cows and the Performance of Fattening Cattle in Low Input Systems of Indonesia and Northern Australia

Contact: Kieren McCosker – Pastoral Production Officer, Beef Cattle

Reference to the DPIF Industry Development Plan 2013-2017:
2.1 Develop and promote more efficient and environmentally sound production systems.

Project Status: Completed.

The StrawCow project was funded by ACIAR and was conducted in Indonesia and Australia. Indonesian domestic beef consumption is increasing by 4% annually but the national herd is increasing by only 1.1%. To meet future beef demand, Indonesian smallholder enterprises need to both increase the number of breeding cattle and also improve their reproductive performance. The factors that limit the productivity of smallholder enterprises in Indonesia are similar to those in the NT, such as time of weaning and the management of bulls and cows on low protein diets. The performance of Brahman cattle in this study was observed under Indonesian village conditions. The study involved 583 Brahman/Brahman cross cattle that were managed by 160 farmers across eight villages in Indonesia.



Locations of project activities in Indonesia

Results

The average pregnancy rate was 24.9% within 100 days of calving and while lactating.

The major factors that affected pregnancy were cow breed, time of calving, cow age group and body condition score (BCS) at calving. Brahman/Brahman cross cows were less likely to be pregnant within 100 days of calving compared with Bali cows (9.5%, vs. 40.8%, respectively). However, they were similar to Ongole cows (8.5%).

The average calf loss in Brahman cattle was 8.1%. High calf losses of 49.7% were observed in Bali cattle at Seputih Banyak. Excluding the high calf losses at Seputih Banyak, the overall calf loss was 6.4%.

The major factors that affected calf losses were cow breed and BCS at calving. The rate of calf losses was lower in Ongole cows compared with either Brahman/Brahman cross or Bali cows.

Calf losses in Bali and Brahman/Brahman cross breeds were similar.

After adjusting for breed, calf losses among cows in BCS ≤ 2 were estimated to be 10% higher than in cows in BCS ≥ 3.

The major factors that affected pre-weaning average daily gain (ADG) were birth weight, cow breed, gender, month of birth , age at weaning, estimated cow age at calving and mating method (artificial insemination (AI) or natural) – a likely factor representing crossbreeding.

Brahman/Brahman cross calves had a higher pre-weaning ADG compared with both Ongole and Bali calves. Ongole calves had a higher pre-weaning ADG compared with Bali calves.

Conclusions

Ongole, Bali and Brahman cows are able to maintain weight on rice straw-based diets if they are supplemented with small amounts of tree legumes to provide additional energy and crude protein.

However, it is difficult to increase the live-weight and BCS of cows fed high amounts of rice straw. The reproductive performance of cows in villages was significantly affected by BCS, with cows in good BCS (≥ 2.5 on a 1 to 5 scale) more likely to become pregnant within 100 days of calving and less likely to lose calves.

Consequently, farmers need to maintain the BCS of cows throughout the year, or strategically feed higher quality diets to increase it.

Recommendations

To increase beef production in Indonesia, the reproductive performance of cows will need to be improved. While the reproductive performance of monitored cows in villages increased during the project, there is still much room for improvement. Two key areas require further research and development: feeding strategies for smallholder farmers to increase both live-weight and BSC of cows, and improved oestrus detection methods, mating management and timely economical access to bulls or AI.

More research is required to identify low-cost and easily available diets that provide enough metabolisable energy and crude protein to increase cow BCS within a short period of time.

Project junior scientists and farmers measure girth, weight and body condition scores of cows (Photo: Di Mayberry)

2.3 The Effect of Hormonal Growth Promotants (HGPs) in Cattle on Net Profit in the Alice Springs District

Contact: Jocelyn Coventry - Pastoral Production Officer

Reference to DPIF Industry Development Plan 2013-2017:
1.2 Facilitate continuous improvement in production quantity and quality.

Project Status: Completed.

This project was part of the 'Alice Springs Trucking Trial' and provided preliminary information on the cost/benefits of using HGPs with respect to Meat Standards Australia (MSA) grading of cattle from the Alice Springs district. The study compared weights, carcase quality and gross abattoir ($) returns for 2011-branded (30-month old) steers, half of which had been treated with Compudose 200 (ELANCO ®).

Results

The use of HGPs improved live-weight gain and carcase weight but did not significantly affect profitability. The average carcase weight of HGP-treated steers was 18 kg (6.1%) heavier than that of untreated steers but MSA downgraded the carcases so they fetched less.

An internal report on the project was provided to ELANCO Animal Health and an audio-visual presentation was made on the findings of the project to the Alice Springs Pastoral Advisory Committee in June 2014. Two articles were published on the project findings in the *Alice Springs Rural Review* (July and September, 2014).

Conclusions

Although the study demonstrated that the use of HGPs increased growth rate, it did not improve profitability. As a corollary, there was benefit in managing cattle turn-off to abattoirs to meet the requirements for MSA grading. Further investigation is required to proscribe management strategies to optimise meat colour and pH of carcases of cattle turned-off from Central Australia to interstate abattoirs.

Industry feedback indicated that the findings on the cost and benefits of HGPs with respect to MSA-grading of cattle from the Alice Springs district were not relevant because buyers were seeking cattle that were not treated with HGPs. This highlights the need to consider both prospective seasonal feed availability risks and target markets when deciding to use HGPs.

Recommendations

Interim recommendations for management to improve profitability of steer turn-off were based on factors that may influence carcase quality or value at abattoirs. These factors are described by abattoir feedback sheets and abattoir grid specifications.

2.4 Accelerating Healing of Cattle Frontal Sinuses Exposed by Dehorning

Contact: Helen McMillan – Pastoral Production Technical Officer

Reference to DPIF Industry Development Plan 2013-2017:
2.1 Develop and promote more efficient and environmentally sound production systems.

Project Status: Completed.

The objective of the project was to assess the effect of patches applied to the exposed sinuses during dehorning on wound healing, calf behaviour and growth. Twenty four dehorned heifers were patched and 26 were not.

Patched heifers showing sealed matrix of blood and cotton patches with reduced blood clots down the side of the face

Results

Patches were difficult to retain with half falling within a day of application. Patches did not significantly improve wound healing or animal behaviour but did appear to reduce blood loss, infection rates and fly strike.

Conclusions

Patches applied to dehorning wounds that expose the frontal sinus do not significantly increase either the rate of healing or the healing outcome. However, patches do reduce post-surgery haemorrhage and the incidence of secondary infection. They may reduce the chance of fly strike and may slightly increase the time taken to reach the post-scab healing phase. This may assist in reducing mortality due to dehorning.

Recommendations

The use of patches is recommended. However, there is a need to develop a cost-effective method to increase their adherence to the wound site. Dehorned animals should be separated from horned animals and, where possible, they should be put on quality pasture.

2.5 Newcastle Waters Cell Grazing Trial: An Evaluation of Cell and Continuous Grazing in the North-Western Barkly Region

Contact: Robyn Cowley – Senior Rangeland Scientist

Reference to DPIF Industry Development Plan 2013-2017:

1.2 Facilitate continuous improvement in production quantity and quality.

1.2.1 Targeted research, development and extension to address agreed industry priorities.

1.2.2 Develop effective research partnerships that support innovation and efficient delivery of extension information to clients.

1.2.5 Deliver improved information on the relative benefits and costs of implementing research outcomes to enable producers to make informed decisions.

2.1 Develop and promote more efficient and environmentally sound production systems.

2.1.1 Improve production and environmental management through innovation.

2.1.3 Continue work to optimise sustainable and productive use of NT rangelands.

2.1.4 Effectively communicate information on the sustainability and efficiency of the Territory's primary production systems to the community.

Project Status: Completed.

The objective of the study was to determine whether cell grazing was a practical and economically viable method for beef cattle production in the region compared with traditional continuous stocking.

Results

There was more spatially-uniform grazing in cell paddocks compared with continuously-grazed paddocks. However, at the species level, preferred species were more heavily grazed than less preferred species in both grazing groups. There was no difference in trends in vegetation between the two grazing groups. Changes in yield, cover and species frequency reflected rainfall and occurred similarly in both the treatment and control paddocks; a fire in the control paddock in late 2004 reduced yields in May 2005. There was an improvement in yield and perennial grass species frequency away from an old water point in the cell system and a decline in pasture composition away from a new water point.

Whilst cell grazing labour and operating costs were higher, the electric fences in the cell groups kept initial infrastructure costs low, mustering costs low per muster and there was considerable improvement in animal temperament - a herd of 1000 animals could be moved and yarded on foot by one person.

Recommendations

When assessing whether a cell system will improve income, you need to take account of infrastructure setup costs, potential carrying capacity with the new system (compared with the current or alternative system carrying capacity), a lower live-weight gain per head in cells, higher ongoing operating costs of cells, a higher skill level and ongoing management inputs required to run cells and potentially higher maintenance costs of cell infrastructure.

To maximise the success of cell grazing, the managers at Newcastle Waters recommended researching cell design and the choice of materials that are adaptable to new challenges and stressed the importance of training staff to use the system.

Conclusion

Cell grazing is considered by managers to be a practical and economically viable production system at Newcastle Waters. The more intensive infrastructure and management of cells facilitated better spatial utilisation of pasture whilst maintaining land condition.

2.6 The Use of Alternative Tropical Breeds Part D: Senepol Crossbreeding Trial

Contact: Tim Schatz – Principal Pastoral Production Research Officer

Reference to the DPIF Industry Development Plan 2013-2017:

1.3 Expand market options for Territory products.

1.3.2 Work collaboratively with industry to identify and respond to potential and actual market disruptions.

Project Status: Continuing.

Brahman cattle have a reputation in Australian domestic markets for having poor meat tenderness. While this has not been a problem in live export markets, high grade Brahman cattle are not as sought after in southern Australian domestic markets. The aim of this project is to investigate whether crossbreeding Senepol bulls with Brahman cows in the northern part of the NT will produce offspring that perform well under NT conditions and have better meat quality than Brahman cattle. If this happens to be the case, then this strategy would increase marketing options for NT cattle producers who now have Brahman herds as they could then produce cattle that would be suitable for both the live export and Australian domestic markets. The crossbreeding project began in late 2008. Following weaning, the male calves are transferred from several research farms to the Douglas Daly Research Farm where their performance over the post-weaning year is studied and compared with Brahman steers that have been managed in the same way. The heifers are retained on native pasture and their performance is studied and compared with that of Brahman heifers raised together. In 2013-14, feedlot performance for 73 days and subsequent meat quality comparisons were conducted using 25 F1 Senepol and 25 Brahman steers.

F1 Senepol x Brahman steers in the feedlot at Lampung, Indonesia

F1 Senepol and Brahman steers grazing improved pasture at Douglas Daly Research Farm

Results

There was no significant difference between genotypes in feedlot performance but the F1 Senepol carcases graded significantly better (two boning groups lower) and their meat was found to be significantly more tender (0.44 kg less shear force). These results show that crossing Brahman cattle with Senepols produces animals with more tender meat.

In a 121-day feedlot trial in Indonesia in 2014, the average daily weight gain in F1 Senepol steers was significantly higher than in Brahman steers (1.71 vs 1.54 kg/day) when fed together.

It has been reported that many Indonesian cattle importers have a strong preference for high grade Brahman cattle over crossbred cattle. The feedlot trial was also conducted to investigate whether this perception was true or it was just an assumption based on previous performance of crosses with British breeds. The results of the feedlot trial show that Brahman crosses with a tropical *Bos taurus* breed will perform as well or better than Brahman under Indonesian conditions. This should mitigate concerns that importers may have about buying such crossbred cattle from the NT.

The results also showed that F1 Senepol calves were heavier by about 20 kg at weaning than the Brahman calves due mainly to hybrid vigour and that they weighed about 10 kg more over the post-weaning year, thereby weighing about 30 kg more at turn-off at around 18 months of age; that F1 Senepol heifers appeared to grow faster than Brahman heifers following weaning and, combined with their heavier weaning weights, they were heavier at joining by about 30 kg and that pregnancy rates in maiden F1 Senepol heifers were about 10% higher.

2.7 Cell Grazing of Improved Pastures for Increased Beef Production and Soil Carbon Sequestration

Contact: Tim Schatz – Principal Pastoral Production Research Officer

Reference to the DPIF Industry Development Plan 2013-2017:

1.2 Facilitate continuous improvement in production quantity and quality.

1.2.1 Targeted research, development and extension to address agreed industry priorities.

1.3 Expand market options for Territory products.

1.3.3 Identify opportunities for primary producers to participate in the climate change and carbon economies.

2.1 Develop and promote more efficient and environmentally sound production systems.

2.1.1 Improve production and environmental management through innovation.

Project Status: Continuing.

This project is comparing the effects of set-stocking and cell grazing on animal and pasture production, pasture composition and sequestration of soil organic carbon (SOC) at the Douglas Daly Research Farm.

The treatments include (a) Cell grazing (CELL), (b) Set stocking constantly at the long-term safe carrying capacity (SSc), and (c) Set stocking at a variable stocking rate that is set to be the same as the effective stocking rate in the cell grazing treatment (SSv).

Young animals are included in the trial shortly after weaning and remain in it for about one year at which time they are replaced by the next year's group of weaners. The large group of animals in the CELL group rotates around 26, 6-ha paddocks while the set-stocked animals remain in the same 6-ha paddock.

Results

Results from this long-term study indicate that individual animal performance was highest in the set-stocking group with the lowest stocking rate and production per hectare was highest in the set-stocking group with the highest stocking rate. The same trend has been seen in the five-year groups studied so far.

In 2013-14, the stocking rate in the SSv and SSc paddocks was the same (nine animals per paddock) and one paddock was excluded in the SSv group due to dieback of buffel grass.

Table 1. Average growth over the whole post-weaning year in the different treatment groups

Year	Treatment	Avg growth / animal (kg)	Avg growth / ha (kg)
2009-10	SSv 1.33 head/ha	137.3	183.0
	SSc 1.5 head/ha	132.7	199.0
	Cell 1.33 head/ha	114.6	152.9
2010-11	SSc 1.5 head/ha	186.0	279.0
	SSv 1.67 head/ha	174.0	289.9
	Cell 1.67 head/Ha	161.2	268.6
2011-12	SSc 1.5 head/ha	167.7	251.6
	SSv 1.83 head/ha	151.9	278.5
	Cell 1.83 head/ha	119.9	219.9
2012-13	SSc 1.5 head/ha	135.6*	203.4*
	SSv 1.83 head/ha	138.0	253.0
	Cell 1.83 head/ha	122.1	223.8
2013-14	SSc 1.5 head/ha	141.2	211.8
	SSv 1.5 head/ha	139.4**	209.0**
	Cell 1.5 head/ha	127.3	191.0

Note: Weights recorded after a 12-hour fast with no feed or water. SSc = Set stocked at a constant rate (1.5 animals/ha), SSv = Set stocked at a variable rate (equivalent to the stocking rate in the cells), Cell = Cell grazing treatment.
*In 2012-13 the average growth in the SSc group was reduced when animals in one paddock had a much lower growth rate than in the other two paddocks (121 kg/head vs 142 kg/head) due perhaps to a higher wallaby grazing in that paddock because of its location.
** In 2013-14, data from Paddock 5 was excluded for SSv due to buffel grass dieback and destocking for three months.

The latest results on pasture and soil carbon measurements will be presented at a later date.

2.8 The Effect of Phosphorus Supplementation on Female Cattle Growth and Fertility

Contact: Tim Schatz – Principal Pastoral Production Research Officer

Reference to the DPIF Industry Development Plan 2013-2017:

1.2 Facilitate continuous improvement in production quantity and quality.

1.2.1 Targeted research, development and extension to address agreed industry priorities.

2.1 Develop and promote more efficient and environmentally sound production systems.

2.1.1 Improve production and environmental management through innovation.

Project Status: Commenced.

Despite a common acceptance among scientists that phosphorus (P) supplementation of cows in deficient country is beneficial, the benefits in northern Australia remain largely unproven by scientific studies and figures show that the adoption of P supplementation is lower than expected. This project aims to study the effects of P supplementation on the growth and reproductive performance of female cattle at Victoria River Research Station. The P supplemented group receives a P supplement throughout life while the control group receives none. Both groups graze in adjacent paddocks that are deficient in P. The groups will alternate paddocks each year.

Weaner heifers in the control group

Collecting soil samples and recording GPS coordinates to determine soil P levels

Results

There are no results at this time.

2.9 A Comparison between the Use of Bopriva and Spaying

Contact: Tim Schatz – Principal Pastoral Production Research Officer

Reference to the DPIF Industry Development Plan 2013-2017:

1.2 Facilitate continuous improvement in production quantity and quality.

1.2.1 Targeted research, development and extension to address agreed industry priorities.

2.1 Develop and promote more efficient and environmentally sound production systems.

2.1.1 Improve production and environmental management through innovation.

Project Status: Commenced.

This project will evaluate the effectiveness of a new drug called Bopriva in preventing pregnancy in cattle and compare it with spaying to turning-off empty cull cows. Traditionally, spaying has been practised to prevent pregnancy in cows intended for culling after a wet season. However, there is a desire to develop a non-surgical method of preventing pregnancy in such situations. This project will evaluate the use of Bopriva for this purpose. This will be timely with the opening of the Darwin abattoir in the near future and the need to prepare cull cows to supply it.

Cows at Victoria River Research Station

Cows at Brunchilly Station

Results

There are no results at this time.

2.10 The Interaction between Weaning Weight and Post-weaning Nutrition on Live-weight Gain and Body Size in Cattle

Contact: Kieren McCosker – Pastoral Production Officer, Beef Cattle

Reference to the DPIF Industry Development Plan 2013-2017:
2.1 Develop and promote more efficient and environmentally sound production systems.

Project Status: Commenced.

The project will investigate several nutritional management strategies for young cattle during their first dry season after weaning and the associated production and welfare implications. Trial animals have been placed in feeding pens and have been provided with trial feeds.

Study animal feeding at the Katherine Research Station

Results

There are no results at this time.

2.11 Selected Brahmans - Improvement in the Fertility of the Brahman Breed through the Use of BREEDPLAN EBVs and Selection

Contact: Whitney Dollemore – Pastoral Research Officer

Reference to the DPIF Industry Development Plan 2013-2017:
2.1 Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

DPIF has been conducting research on improving the fertility of a Brahman herd since 1986. The herd was established using females from DPIF Research Stations and bulls from the local area. A high selection pressure was used. It involved yearling mating of heifers and a strict culling regime for females more than two years old. Bulls were selected at 12 and 18 months of age on testicular size, growth and dam performance. Artificial insemination (AI) was also used to introduce outside genes. AI sires were selected using a selection index that places high importance on low days to calving, high scrotal circumference and estimated breeding values (EBVs). The herd joined the Australian Brahman Breeders' Association and became a member of BREEDPLAN in 1994. Herd data from 1986 to now was recorded. The current project continues previous work in selection based on EBVs and herd performance. In addition, it aims to increase the herd size (while maintaining strict selection), extend the knowledge of selection practices used and share the gene pool through bull and semen sales. In 2013-14 there was renewed selection for early pubertal bulls based on both dam age at first calf, semen evaluation using laboratory analysis as well as crush-side and polledness. The herd now has 187 females at Victoria River Research Station (VRRS) and 212 first and second-calf heifers, 53 bulls (49 bulls were sold) and 249 yearlings at Douglas Daly Research Farm (DDRF).

Composite and selected Brahman sires

Results

The average days to calving and scrotal circumference (reproduction traits) EBVs for our herd (Herd 4299) are well above the breed average for Brahman group's BREEDPLAN. The updated 2014 group BREEDPLAN figures show that the herd continues to be above the Brahman group average for the Jap Ox index, the Northern Live Export index, as well as most EBV traits and particularly high for fertility traits.

The extension of this project includes presentations at NT Field Days (September 2014), the VRRS Field Day (August 2014), the AACo Forum (February 2014), radio and newspaper interviews and a number of *Katherine Rural Review* articles.

The following notable results have been observed at Round 1 muster (May 2014):

- 15% of yearling heifers (2013) were detected pregnant at DDRF.
- A 74% (17/23) re-conception rate in 2012 lactating first-calf heifers at DDRF.
- A 77% (44/57) wet cow re-conception rate in 2011 heifers at DDRF.
- A 83% (57/69) weaning rate in 2011 heifers at DDRF.
- A 75% (114/153) wet cow re-conception rate in breeders at VRRS.
- A 15% (26/179) calf loss at VRRS.

The pregnancy rate of the breeder herd at VRRS was higher in 2014 than in previous years. The pregnancy rate in yearling mated heifers at DDRF was lower than in previous years due to a lower average joining weight as a result of nutritional limitations. Calf losses at VRRS were higher than normal (average 8%) perhaps due to an increased presence of dogs or the inclusion of B grade breeders, which were removed at WR1 2014.

Selected Brahman heifer calves at Douglas Daly Research Farm - February 2014

2.12 Improving Breeder Herd Efficiency in the Arid Region with Performance Recording and Objective Selection

Contact: Jocelyn Coventry – Pastoral Production Officer

Reference to the DPIF Industry Development Plan 2013-2017:
2.1 Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

This project uses a breeding herd of Droughtmaster-infused cattle at Old Man Plains Research Station (OMPRS) in the arid region to demonstrate benchmarking of herd performance, best-practice management, bull breeding soundness evaluation, genetic improvement through objective selection and BREEDPLAN recording.

Feeding supplementary pellets to weaner cattle in 2014 – combined Droughtmaster and Droughtmaster-cross groups

Results

By February 2014, 513 Droughtmaster cattle were identified and recorded on the Droughtmaster database for BREEDPLAN performance recording.

In 2013-14, 54 naturally-bred calves were selected for potential entry on the Droughtmaster database for BREEDPLAN performance recording. The selection of the calves was based on recording birth dates using remote technologies, visual observations and confirmation of parentage based on DNA.

The weaning rate of calves with pregnant dams was 85.8% in the naturally-mated group in 2013 at OMPRS.

Calf losses in 2013 occurred in the third trimester (0.8%), perinatal (3.9%), postnatal (5.5%) and unknown (3.9%) at OMPRS. Two foetal calf losses were associated with maternal death.

The pregnancy rate was 85.7% in 2014. Calving records in 2013 and rainfall records during mating (December 2013 to February 2014) showed that most cows that did not re-conceive had calved either very early or very late in the calving season. While lactation anoestrus may explain the lack of pregnancy in late-calving cows, it is hypothesised that a large rainfall event during the second month of mating may have resulted in surface water that allowed cows with large calves to graze at a distance from, rather than close to, the controlled watering point (trough) where the introduced herd bulls usually remained. Evidence of

foetal loss and early developmental abnormalities in 2014 suggest that plant toxins may have contributed to a lower pregnancy rate.

Culling to meet herd breeding objectives and to improve the efficiency of the Droughtmaster herd contributed to the replacement of over 37% of the herd bulls and 19% of the breeding cows in 2014. Three quarters of the culled cows (18/24) were ‘empty’ based on rectal palpation in May, 2014. Although all cows had successfully calved in the previous season, they were moved to another project. Another six cows were culled because they were ‘aged’ or had undesirable genetic attributes, such as horns.

The first Droughtmaster calf for 2014

2.13 A Comparison between the Productivity of a Multi-breed Composite and a Brahman Breeder Herd

Contact: Barry Lemcke – Principal Livestock Management Officer

Reference to the DPIF Industry Development Plan 2013-2017:
1.2 Facilitate continuous improvement in production quantity and quality.

Project Status: Continuing.

The limitations of the Brahman breed for the Top End of the NT are well known and the search for a better alternative has been ongoing. Finding a breed that can also be suitable for a southern market is paramount should the South-East Asian export markets fail, as happened in 2011. This project compares the performance of a multi-breed composite under Top End conditions and assesses its suitability as an alternative to the Brahman breed. A multi-breed composite is able to combine the attributes of a larger number of breeds and capture a larger amount of heterosis than conventional two-breed crossings. The composite is 56.3% Brahman, 12.5% Africander, 12.5% Tuli, plus 6.3% each of Shorthorn, Hereford and Charolais. This mix is 81% tropically-adapted and 19% unadapted *Bos taurus*. Some other breeds, such as Senepol, have been introduced to heifers through artificial insemination to see whether they can contribute to overall productivity. The composite is expected to retain 64% of heterosis in the second generation onwards. The two breeds are run together except during mating between January and March. Their performance is assessed through BREEDEPLAN, which is also used to select bulls for breeding and for sale. Females are culled if they miss getting pregnant at two years of age or any time as mature cows four years old or older. A yearling heifer that calves as a two-year-old is allowed one missed pregnancy, but thereafter there are no exceptions. Cows are culled if they do not raise a calf to weaning, unless due to a known accidental cause. Herd numbers are now limited to about 80 to 90 animals at mating so a substantial number of pregnant females are available for sale to the industry annually. Now selection for polled animals is emphasised.

A young selected composite bull at Douglas Daly Research Farm

Results

Table 1. Herd numbers in 2013-14

	Composite breeder herd at BHF*	Brahman breeder herd at BHF	Composite three-year-old heifers at DDRF (at mating)	Composite two-year-old heifers at DDRF (at mating)	Composite yearling heifers at BHF (at mating)	Composite yearling heifers at DDRF	Brahman yearling heifers at BHF
Herd size at start of mating 2014 (number)	95	89	73	92	36	45	28
Pregnancy rate 2013 mating	94.4% (n=89)	77.3% (n=88)	94.3% (n=70)	83.3% (n=78)	No yearling group at BHF	72.3% (n=94)	74% (n=27)
No. culled at preg test Jun-14 (% of breeders mated)	16 (15.4%) (7 not pregnant; 9 dry)	36 (40.4%) (n=89)	6 (8.2%) (n=73)	2 / 2.2% (n=92)	None culled	None culled	None culled
Pregnancy rate 2014	92.6% (n=95) All non-pregnant Culled	77.5% (n=89)	91.8% (n=73) All non-preg culled	82.6% (n=92)	80.6% (n=29)	44.7% (n=47)	7.1% (n=28)
Mean birth wt (kg) of calves born in 2013-14	27.0 kg (n=90)	28.6 kg (n=73)	25.6 kg (n=61)	23.0 kg (n=73)	NA	NA	26.3 kg (n=12)
Calf mortality to weaning	9 / 92 (9.9%)	11 /74 (14.9%)	2 /61 (3.3%)	9 / 73 (12.3%)	NA	NA	3 / 15 (20%)
Number of calves weaned	83	63	59	64	NA	NA	12
Weaning rate (%)	87.4%	70.8%	96.7%	87.7%	NA	NA	80%
Mean weaning wt (kg)	211.5 kg	195.5 kg	149.4 kg	148.0 kg	NA	NA	141.4 kg
Adult breeder mortality	1	1	0	1	0	1	0

*BHF = Beatrice Hill Farm. DDRF = Douglas Daly Research Farm.

Composites continue to out-perform Brahman cattle in production, reproduction and lower culling rates. Calf mortality rate is still disappointingly high, which is also associated with dingo attacks and problems related to bottle teats in older breeders, which are subsequently culled. Calf mortality is highest in first-calf heifers and may be due to inexperience in mothering or difficulty in calving at lower live-weights. Adult mortality was low.

Collaborating staff: G. Hamilton, R. Mc Donald, D. Dickerson, J. Palmer, S. Thomas, C. Hazel and P. and S. Shotton

2.14 Riverine Buffalo and Crossbreeding Project

Contact: Barry Lemcke – Principal Livestock Management Officer

Reference to the DPIF Industry Development Plan 2013-2017:
1.2 Facilitate continuous improvement in production quantity and quality.
1.2.1 Targeted research, development and extension to address agreed industry priorities.

Project Status: Continuing.

Riverine buffalo were imported from the USA between 1994 and 1997. They were the foundation for the Australian buffalo dairy industry. Crossbreeding with the local swamp buffalo allowed for an expansion in animal numbers and also improved growth rates in calves by 40%, enabling the production of quality meat (TenderBuff) due to a younger age at slaughter, which improved tenderness and therefore profitability. It also enabled milk production more rapidly, based on cheaper first and subsequent crosses, whilst backcrossing to riverine. Imported Italian dairy buffalo semen has also facilitated the expansion of the herd and prevented inbreeding problems due to the low starting population base. The target is 100 purebred breeders able to turn-off around 40 purebred heifers per year to the industry.

Results

Table 1. Calving and pregnancy rates in 2013-14

Breeder group	Calving rate (%) 2013-14 calves born/cows mated	Pregnancy rate (%) cows preg July 2014 / cows mated Jan 2014	Pregnancy rate in wet cows (%) (preg wet cows/total wet cows
F1 cows	81.3 (n=16)	93.8 (n=16)	92.3 (n=13)
3/4 cows	95.0 (n=40)	73.3 (n=45)	65.7 (n=35)
7/8 cows	84.9 (n=37)	22.9 (n=39)	18.5 (n=27)
15/16 cows	71.9.(n=32)	77.4 (n=31)	79.2 (n=24)
Two-year-old crossbred heifers (continued mating)	100 (n=26)	Not tested	NA
Crossbred yearling heifers (continued mating)	NA	86.8 (n=38) mating still continuing	NA
Two-year-old purebred heifers(continued mating)	94.6 (n=37)	Not tested	NA
Purebred yearling heifers(continued mating)	NA	57.9 (n=38)	NA
Riverine cows	45.6 (n=82)	28/9/13 12 / 37 = 32.4 21/3/14 14 / 36=38.9 16/5/14 18 / 39=46.2	8/22 =36.4 6/14 =42.9 7/14 =50
Old P/B group	62.5 (n=16)	Not tested	Not tested
Total	73.0 (n=270)	65.7 (n=207) excluding AI groups	62.6 (n=99) excluding AI groups

Pregnancy rates in the 7/8 cow group were much lower than usual indicating a problem with bulls.

The objective of 100 purebred breeders was achieved during the year allowing sales to the 10 buffalo milk dairies in Australia.

A new live export market for buffalo to Vietnam opened in February 2014 and 3516 animals were exported. Thirty six crossbred heifers were shipped to Victoria.

The local Darwin buffalo dairy moved to a larger property near Batchelor and is building its infrastructure.

Collaborating staff: G. Hamilton, R. Mc Donald, D. Dickerson, J. Palmer and T. Schatz

The four foundation cows from the United States

Buffalo steers grew faster than Brahman or composite steers while grazing "together" at Berrimah Farm during the dry season

2.15 TenderBuff Development and Supply

Contact: Barry Lemcke – Principal Livestock Management Officer

Reference to the DPIF Industry Development Plan 2013-2017:
1.2 Facilitate continuous improvement in production quantity and quality.
1.2.1 Targeted research, development and extension to address agreed industry priorities.

Project Status: Continuing.

TenderBuff is a registered trade name for buffalo meat held by the NT Buffalo Industry Council to provide a high quality product from a small supply base. To achieve that quality, an animal must comply with five specifications: 150-300 kg hot carcase weight, 3-12 mm of P8 fat, no permanent incisor teeth, the carcase must be electrically stimulated (or tender-stretched) and be below pH 5.8 after hanging overnight in the chiller.

To produce TenderBuff in the NT, it is necessary to run buffalo on improved pastures to achieve the growth rates required or to feedlot feral captured animals for at least two months to bring them up to a suitable standard. Access to floodplain pasture in the dry season is also an advantage, or alternatively, dry season irrigated pasture or fodder can be used.

Last of the two-year-old crossbred steers ready for export

Results

The absence of an abattoir prevented the production of TenderBuff this year. Male buffalo have been either exported or, if too large, sold for pet meat production locally.

2.16 Stocking Rate and Pasture Spelling Demonstration – Alexandria Station

Contact: Helen McMillian – Pastoral Production Technical Officer

Reference to the DPIF Industry Development Plan 2013-2017:

2.1 Develop and promote more efficient and environmentally sound production systems.

2.1.3 Continue work to optimise sustainable and productive use of NT rangelands.

Project Status: Continuing.

The project intends to demonstrate the benefits of wet season spelling and sustainable stocking rates for maintaining good land condition at new bores and improving land condition at old bores. The demonstration commenced during the now completed Northern Grazing Systems project, which aimed to develop practical, region-specific management options for managing issues which impact on the profitability and sustainability of the northern beef industry.

Results

The results show that average annual utilisation rates in the demonstration paddock were within recommended levels for Mitchell grass pastures in the Barkly (<20-25%).

Naturally treeless paddock full of Mitchell grass

2.17 Pasture Sustainability - Kidman Springs

Contact: Dionne Walsh – Rangeland Program Manager

Reference to the DPIF Industry Development Plan 2013-2017:

2.1 Develop and promote more efficient and environmentally sound production systems.

2.1.3 Continue work to optimise sustainable and productive use of NT rangelands.

Project Status: Continuing.

The aims of this long-term research project are to monitor pastures and land condition at Victoria River Research Station, verify whether the recommended stocking rates derived by Cowley and Bryce (2003) are sustainable and refine objective carrying capacity methods to improve advice to the industry.

Results

Four observers conducted annual pasture monitoring on 14 paddocks in June. A preliminary report on pasture and land condition performance showed that a revision of the carrying capacity estimates on all paddocks is warranted.

2.18 Northern Grazing Carbon Farming - Integrating Production and Greenhouse Gas Outcomes (Climate Clever Beef 2)

Contact: Dionne Walsh – Rangeland Program Manager

Reference to the DPIF Industry Development Plan 2013-2017:

1.3 Expand market options for Territory products.

1.3.3 Identify opportunities for primary producers to participate in the climate change and carbon economies.

Project Status: Continuing.

The aim of this project is to identify practices that improve both animal productivity and emissions performance, trial and demonstrate practices that can reduce emissions from cattle and/or increase carbon sequestration in soils and vegetation, and assess the economic benefits of the practices and determine whether there is a business case for northern beef producers to participate in “carbon farming” projects.

Cattle at Douglas Daly Research Farm

Mitchell grass plains in good land condition

Results

Improved genetics, animal selection and property development over 30 years have sustainably increased herd size, weaning rates and animals turned-off; they have also significantly reduced mortality rates in one of the businesses studied. This has improved gross margins and reduced greenhouse emissions intensity per tonne of live-weight of animals sold by over 40%; it has also increased the weaning rate, reduced breeder mortality, increased live-weight and improved gross margins and profits. The potential income from the emissions abated (from the reduction in herd size) was up to $60 000 per year.

Soil organic carbon was found to be relatively low in productive black soils on the Barkly (typically 10 to 15 tonnes per hectare in the top 30 cm). There was no negative effect on long-term grazing duration (100 years) or on different grazing intensities on soil carbon stocks on the robust black soils. The potential for soil carbon sequestration in these soils appears low.

Soil carbon results from the Douglas Daly suggest that the longer cleared land is left before further development, the more time there is for dead organic matter to break down and for regrowth to occur and contribute to soil carbon stocks.

The Douglas Daly sites indicate that improved pasture development has the potential to return soil carbon stocks to pre-clearing levels.

The project has been promoted at field days, conferences and in the media. Project case studies and fact sheets are available at http://futurebeef.com.au/resources/projects/climate-clever-beef/

2.19 Shruburn (VRRS Long Term Fire Experiment)

Contact: Robyn Cowley – Senior Rangeland Scientist

Reference to the DPIF Industry Development Plan 2013-2017:

1.2 Facilitate continuous improvement in production quantity and quality.

1.2.1 Targeted research, development and extension to address agreed industry priorities.

1.2.4 Support industry to understand, and adapt to, changes in climate.

1.2.5 Deliver improved information on the relative benefits and costs of implementing research outcomes to enable producers to make informed decisions.

2.1 Develop and promote more efficient and environmentally sound production systems.

2.1.3 Continue work to optimise sustainable and productive use of NT rangelands.

Project Status: Continuing.

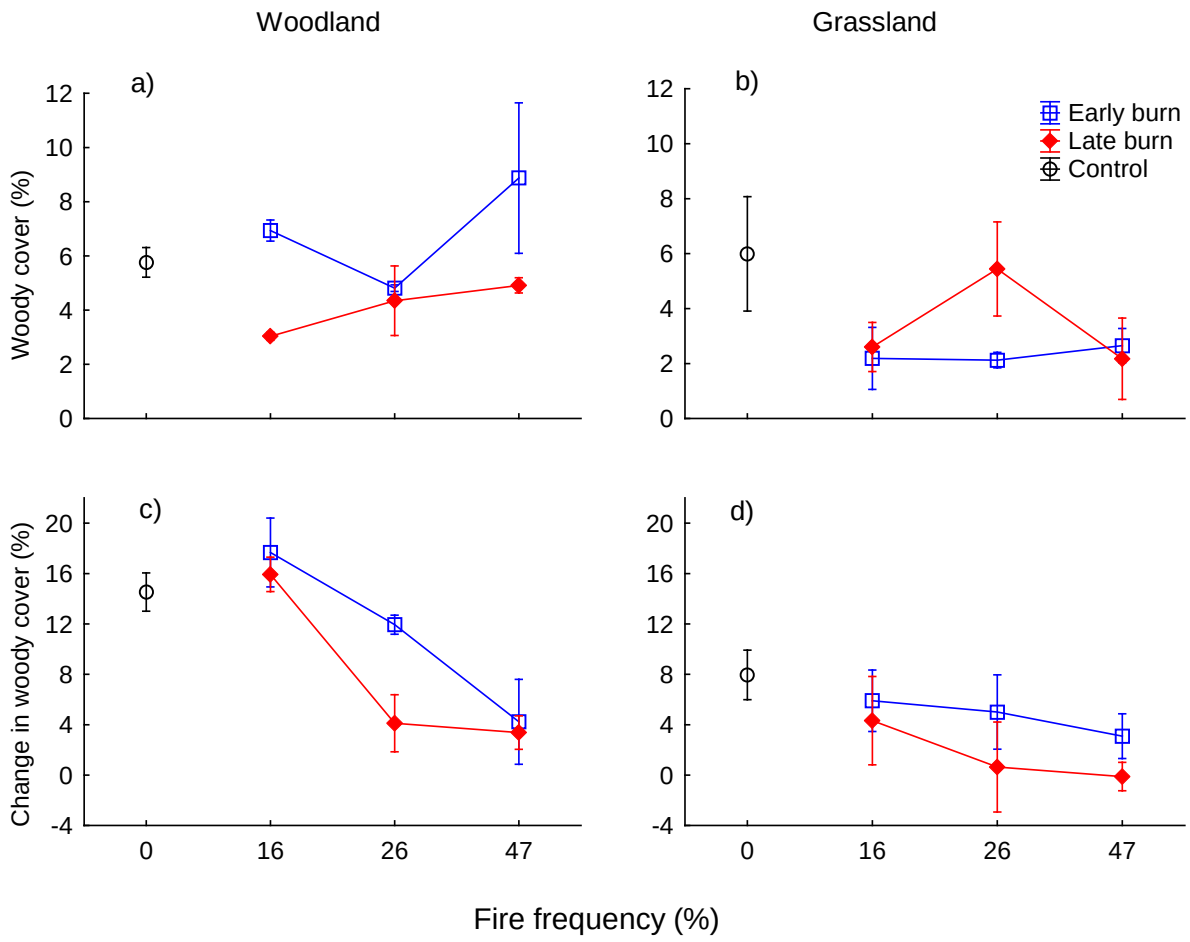
The long-term Kidman Springs Fire Trial, which was established in 1993, assesses the impact of fire management on woody cover and pasture condition. The trial is replicated on red and black soil sites, with grazed experimental plots burnt early or late in the dry season, every two, four and six years, and compared with unburnt control plots. Aerial images taken from a helicopter were digitally analysed to provide woody cover change at the site between 1995 and 2013.

Fire plot after an experimental fire at Kidman Springs June 2013

Monitoring pastures at Kidman Springs fire experiment on red soil in June 2013

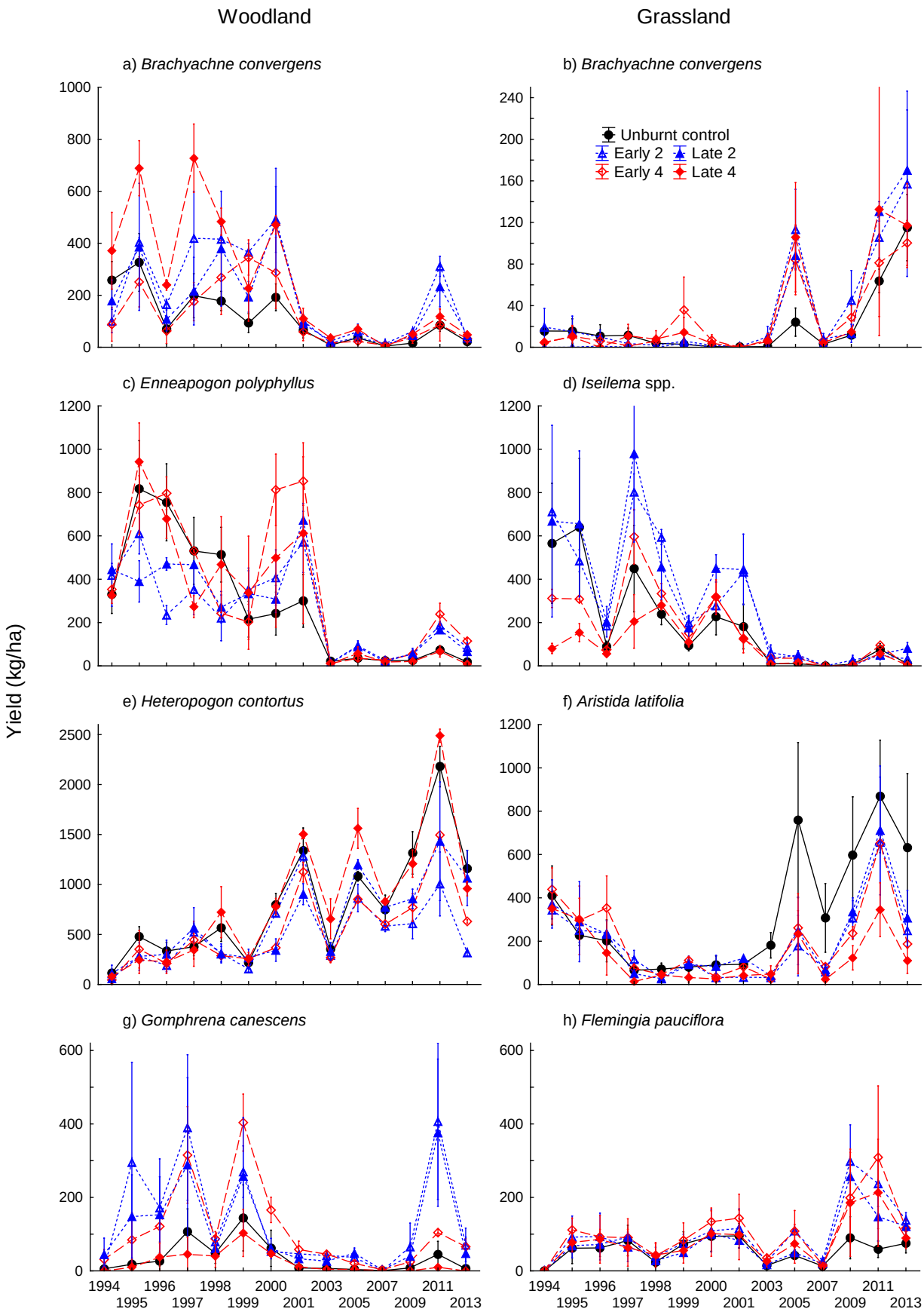
Results

Over an 18-year period, woody cover increased by 4% (absolute) on the red soil even with the two-yearly late season fire use. With less severe or no fire, woody cover increased by 12 to 17%. On black soil, woody cover remained static when subjected to late dry season fires every two or four years, but increased by 3% to 6% under less severe fire use and by 8% when unburnt. Major shifts in under-storey species composition occurred at both sites, regardless of fire regime. The effect of fire on yield and pasture composition was compounded by higher grazing after fires. Perennial grass declined and annual grass and forb yield increased following early or frequent fires. *Brachyachne convergens*, *Gomphrena canescens*, and *Flemingia pauciflora* increased in response to fire while *Aristida latifolia* and *Heteropogon contortus* decreased. Four-yearly late dry season fire provided the most effective management of woody cover and pasture composition. Although early dry season fire is recommended for biodiversity management and for reducing greenhouse gas emissions in tropical savannas, on grazed pastoral land it can promote woodland thickening and pasture degradation.



Woody cover (mean ± SE) in 1995 (a and b) and absolute change between 1995 and 2013 (c and d) with different fire treatments

Lighting a fire on a red soil plot at Kidman Springs in June 2013



Changes in species yield in response to fire regime (mean ± SE)

2.20 Making Production and Conservation Gains through Adaptive Grazing: Beetaloo Pilot Project

Contact: Jane Douglas – Pastoral Technical Officer

Reference to the DPIF Industry Development Plan 2013-2017:
2.1 Develop and promote more efficient and environmentally sound production systems.
2.1.3 Continue work to optimise sustainable and productive use of NT rangelands.

Project Status: Continuing.

The aim of this project is to evaluate and promote grazing land management practices, infrastructure development and animal productivity improvements that will increase business resilience in the Barkly pastoral region. The project is funded by *Caring for our Country* in collaboration with DPIF, the Barkly Landcare and Conservation Association and Beetaloo Station.

Rotation paddocks at Mungabroom Station

Bulls at Mungabroom Station

Results

Four observers completed pasture monitoring during May. A paddock walk was held at the site for attendees of the Barkly Herd Management Forum 2013.

2.21 Delamere Burning and Wet Season Spelling Demonstration

Contact: Jodie Ward – Pastoral Technical Officer

Reference to the DPIF Industry Development Plan 2013-2017:

2.1 Develop and promote more efficient and environmentally sound production systems.

2.1.3 Continue work to optimise sustainable and productive use of NT rangelands.

Project Status: Continuing.

This demonstration trial commenced during the Northern Grazing Systems project (2009- 2012). It aims to provide recommendations on the use of wet-season spelling with and without early wet-season burning to improve pasture quality and land condition on black soils in the Victoria River District. Two observers completed pasture monitoring in May.

Post three-yearly burn on half the treatment plots, December 2013

Early morning at the trial site at Delamere

2.22 Central Australian Quality Graze Trial and Producer Steer Challenge

Contact: Chris Materne – Pastoral Production Officer

Reference to the DPIF Industry Development Plan 2013-2017:
2.1 Develop and promote more efficient and environmentally sound production systems.

Project Status: Continuing.

This project aims to demonstrate and test the impact of various grazing strategies on land condition and consistent production of quality beef in Central Australia.

A mix of breeds entering the Quality Graze Producer Steer Challenge

Steers branded in 2012 from the Central Australian Quality Graze trial ready for trucking to a premium quality beef market

Results

No grazing strategy treatment effect was detected from the pasture assessments at this early stage. The steers branded in 2012 were sent to abattoirs and were MSA-graded for meat quality in April 2014. Most of the steers branded in 2012 reached target in terms of average growth weight of 0.5 kg/day (87%), p8 fat depth of more than 5 mm (90%), ossification score of less than 175 (74%), and fat colour of less than 4 (79%). Most of the steers branded in 2012 (95%) also met the dentition target of less than 6; however, only 38% met the less than 4 target and only 22% met the meat colour target of less than 4. Only 15% of the steers branded in 2012 achieved MSA grading.

A poster on the project was presented at the 2013 Northern Beef Research Update conference (12-15 August 2013).

Presentations were made at the Bi-annual OMPRS Field Day, ‘Marketing Quality Beef from Quality Land’, during an ABC interview promoting the field day; promoted the Quality Graze Trial at the Tourism NT launch of the NT Business Events Ambassadors Program in Alice Springs and to a Chinese delegation – Yu Xiang Yuan in Alice Springs.

2.23 Precision Pastoral Management Tools (PPMT) Project

Contact: Sally Leigo – Principal Research Leader

Reference to the DPIF Industry Development Plan 2013-2017:

1.2 Facilitate continuous improvement in production quantity and quality.

1.2.1 Targeted research, development and extension to address agreed industry priorities.

2.1 Develop and promote more efficient and environmentally sound production systems.

2.1.1 Improve production and environmental management through innovation.

Project Status: Continuing.

The PPMT project aims to develop a commercial precision pastoral management system (PPMS) based on integrated modules that are compatible with existing software and hardware. PPMS will integrate precision data on cattle and pasture performance using minimal labour. Four research sites were established and work commenced at Glenflorrie Station (Pilbara, WA), Newcastle Waters Station (Barkly Tableland), "Tarrina" (via Tambo, Qld) and Undoolya Station (Central Australia).

Results

Improvements to PPMS have enabled producers to access property maps that can now show pasture greenness. Results were presented at the Ninti-One 10-year Anniversary function in Canberra, the North Australia Beef Research Update Conference (NBRUC), the Territory Business Events Delegates, ABARES Ground Cover workshop, the Territory Natural Resource Management Annual Forum and delegates from the Chinese YXY Company. The project's first update was published and distributed to stakeholders. Two posters were presented at the proceedings of NBRUC and a paper was published in the US journal *Rangelands*.

Participants discuss PPMS

PPMS at Newcastle Waters

3 Plant Industries

Due to a recent outbreak of the cucumber green mottle mosaic virus disease in the NT, it was not been possible to include reports on the plant industry sector because research officers were engaged in the control of the disease. Their contribution will be published in next year's report.

External Recognition

The following is a summary of the 2013-14 internal and external awards and invitations to significant meetings and conferences.

Robert Barigye	Received an award with a $250 value for best oral presentation at the Australian Society of Veterinary Pathologists Annual Conference, 11-13 Oct 2013.
	Was nominated for the 2014 STAR Award, the Department of Primary Industry and Fisheries.
Jocelyn Coventry	Presented highlights of the Master's thesis at Charles Darwin University (Rangeland Biology and Ecology Seminars, June 2014).
	Invited to make a poster presentation at the XXVII World Buiatrics Congress, Cairns, July-August 2014.
	Invited to present highlights of the Master's thesis at Murdoch University, August 2014.
Robyn Cowley	Invited speaker at the Adelaide River and Mataranka 'Beef Up' Forums in August 2013.
	Invited speaker at the Northern Beef Update Conference in Cairns August 2013.
Sally Leigo	Invited presenter at the ABARES Ground Cover workshop, Canberra 2014.
	Invited presenter at the Southern NT NRM Annual Forum, Alice Springs 2014.
	Invited presenter at the Marree Field Day 2014, Maree, South Australia.
Lorna Melville	Awarded the Chief Minister's Public Sector Medal.
	Awarded the Australian Public Service Medal.
Tim Schatz	Invited speaker at 'Beef-Up' Forums at Adelaide River and Mataranka, the AACo. Head Stockmen's course and the Barkly Herd Management Forum.
Dionne Walsh	Session Chair - "Managing Pastures 2", Northern Beef Research Update Conference, Cairns, August 2013.
	Winner of the 2013 Knowledge Seminar Award: "Is there a business case for NT cattle producers to 'farm' carbon"?"

Staff and Students

Science Staff	Graduate Students
Biosecurity and Product Integrity	
Robert Barigye (Research Fellow)	Mr. Winston Kabiswa - MSc thesis titled: "Antibiotic susceptibility patterns and genetic backgrounds of *Escherichia coli* isolates of avian origin" - Makerere University, Uganda (College of Veterinary Medicine and Biosecurity), Microbiology.
Lorna Melville (OIC Veterinary Laboratories	
Pastoral Production	
Jocelyn Coventry (Pastoral Production Officer)	
Robyn Cowley (Senior Rangeland Scientist)	
Whitney Dollemore (Pastoral Research Officer)	
(Natalie) Jane Douglas (Pastoral Technical Officer)	
Sally Leigo (Principal Research Leader)	Collin Marshall – Precision Pastoral Management System Interface – Charles Darwin University.
Barry Lemcke (Principal Livestock Management Officer)	
Kieren McCosker (Pastoral Production Officer – Beef Cattle)	Whitney Dollemore – Master's in phosphorus nutrition in beef cattle – University of Queensland (Animal Studies). Tiago Alves Correa Carvalho da Silva - Research based PhD in post-weaning growth in heifers – University of Queensland (Animal Studies).
Helen McMillian (Pastoral Production Technical Officer)	
Chris Materne (Pastoral Production Officer)	
Caroline Pettit (Rangeland Research Officer)	
Tim Schatz (Principal Pastoral Production Research Officer)	
Dionne Walsh (Rangeland Program Manager)	
Jodie Ward (Pastoral Technical Officer)	

Research Visitors

Visitor	Affiliation	DPIF Contact
The Animal Ethics Committee visited DDRF.		Tim Schatz
Brazilian and Mexican PhD students visited VRRS.		Tim Schatz
Farmers from WA visited Beatrice Hill Farm.		Barry Lemcke
Dr Geoffry Fordyce	Senior Research Fellow, Centre for Animal Science, Queensland Alliance for Agriculture and Food Innovation.	Kieren McCosker
Indonesian and Vietnamese delegations visited Beatrice Hill Farm to inspect buffalo.		Barry Lemcke
Professor Dennis Poppi,	Professor in Animal Nutrition, School of Agriculture and Food Sciences – The University of Queensland.	Kieren McCosker
Various	Welcomed CSIRO visitors to OMPRS, including a presentation on the Quality Graze trial.	Chris Materne
Various	Two groups of beef producers from the pastoral zone of NSW visited the PPMT project (December 2013 and June 2014).	Sally Leigo
Various	A Chinese delegation from the XYX Company visited the PPMT project (February 2014).	Sally Leigo
Various	Territory Business Events Delegates visited the PPMT project (February 2014).	Sally Leigo

Research Service

The following is a summary of science staff participation on significant scientific, industry or policy development committees and editorial boards.

Robert Barigye	Reviewed two manuscripts for the *Journal of Veterinary Diagnostic Investigations.*
Robyn Cowley	Associate Editor for the Special Issue of *The Rangeland Journal* – Savanna Burning: role and opportunity in a rangeland carbon economy (2014). Reviewed a scientific paper for *The Rangeland Journal*.
Sally Leigo	Guest Editor for the US Society for Range Management's journal *Rangelands* - special edition: Women as Change Agents in the World's Rangelands. Program sub-committee member for the Australian Rangeland Society's 18th Biennial Conference.
Lorna Melville	National Arbovirus Monitoring Program Technical Committee.
Tim Schatz	DPIF representative on the North Australia Beef Research Council (NABRC). Member of the NABRC Management Committee. Attended the Katherine Pastoral Industry Advisory Committee meetings.
Dionne Walsh	Guest Editor, Special Issue of *The Rangeland Journal* (Savanna burning in a carbon economy), published in September, 2014. Member – Program Subcommittee, the 2015 Australian Rangeland Society Conference.

External Linkages

Industry Collaboration – details of specific collaborative industry-focused projects.
Research Collaboration - details of specific collaborative research projects or consortia.

Name	(I) Industry Collaboration / (R) Research Collaboration
Jocelyn Coventry	(I) Collaborated with Elanco Animal Health and the Alice Springs Pastoral Advisory Committee on the HGP/MSA trial in 2013-14. (R) Collaborated with Mr. Tim Driver and Mr. James Christian from Precision Pastoral Pty Ltd in presenting a poster on research, development and the use of a remote livestock management system.
Robyn Cowley	(R) Worked with Stefan Maier, Karen Joyce and Miguel Tovar from Charles Darwin University to analyse woody cover for the Kidman 'Shruburn' trial.
Whitney Dollemore	(I) Animal welfare and handling course, Indonesia. (R) Intensive genotyping and phenotyping for accelerated genetic improvement of reproduction in northern Australia, AGBU.
Jane Douglas	(I) Spelling, stocking rate and infrastructure development demonstration trial at the Beetaloo-Mungabroom Station trial, which is a collaborative project with the Dunnicliff and Armstrong families, the Barkly Landcare and Conservation Association and DPIF. (I) Speaker at the Barkly Herd Management Forum – Beetaloo Station, 2013; the Northern Beef Research Update Conference – Cairns 2013 and the Barkly Rangeland Management Course – Brunchilly Station, 2014. (I) A coordinator for the 2013 Barkly Herd Management Forum at Newcastle Waters, Beetaloo and Anthony Lagoon stations.
Sally Leigo	(I) PPMT includes the North Australia Pastoral Company, the NT Cattlemen's Association, Observant P/L and Precision Pastoral P/L. (R) PPMT is conducted in collaboration with the CRC for Remote Economic Participation, Queensland, WA, SA and the University of New England.
Barry Lemcke	(I) MLA-funded overseas cattle export in-country assistance (Vietnam in 2013-14). (I) Honorary member of the Australian Buffalo Industry Council. (I) Associate member of the NT Buffalo Industry Council. (I) Vice-President for Oceania on the International Buffalo Federation.
Kieren McCosker	(I) Attended Katherine Pastoral Industry Advisory Committee meetings. (R) Collaborating in the ACIAR-funded StrawCow project currently being conducted in Indonesia.

External Linkages

Industry Collaboration – details of specific collaborative industry-focused projects.
Research Collaboration - details of specific collaborative research projects or consortia.

Name	(I) Industry Collaboration / (R) Research Collaboration
Helen McMillian	(I) Spelling and stocking rate demonstration trial at Alexandria Station, in collaboration with the North Australian Pastoral Company, DPIF and the Australian Government. (R) Mittiebah dehorning trial, investigating the efficacy of a patch on dehorning wounds – a collaborative project between the University of Queensland, MLA and DPIF. (R) Presented the Barkly Rangeland Management Course at Brunchilly Station, Brunette Downs Station and Anthony Lagoon Station. (R) One of the coordinators for the 2013 Barkly Herd Management Forum – Newcastle Waters, Beetaloo and Anthony Lagoon stations.
Chris Materne	(I) Presented an overview of the Central Australian cattle industry to a Chinese delegation – Yu Xiang Yuan in Alice Springs. (I) Provided modelled carrying capacity estimates to Monique Medway for Walhallow/Cresswell Downs Station. (I) Provided modelled carrying capacity estimates to the Alatyeye Aboriginal Corporation. (I) Provided modelled carrying capacity estimates to the Mungoobarda Aboriginal Corporation on Robinson River grazing lands.
Lorna Melville	(R) NSW Agriculture – Elizabeth Macarthur Agriculture Institute: Detection of bluetongue virus and vectors to enhance surveillance. (R) Australian Animal Health Laboratory: Bovine ephemeral fever virus evolution in Australia. (R) Medical Entomology, NT Department of Health. Investigating novel methods of detecting flavivirus activity in mosquitoes and investigating possible reservoirs of the Barmah Forrest virus.
Caroline Pettit	(R) Provided carrying capacity data to Dr Miguel A. Bedoya-Pérez for his spatial modelling of wallaby populations across the VRD, Sturt Plateau and Douglas Daly regions.

External Linkages

Industry Collaboration – details of specific collaborative industry-focused projects.
Research Collaboration - details of specific collaborative research projects or consortia.

Name	(I) Industry Collaboration / (R) Research Collaboration
Tim Schatz	(I) Collaborated with Elders Indonesia on a research project in a Lampung feedlot.
	(I) Spoke at the Barkly Herd Management Forum.
	(I) Spoke at Beef-Up Forums at Adelaide River and Mataranka.
	(I) Collaborated with the manager of Brunchilly Station on phosphorus research.
	(I) Collaborated with the manager of Helen Springs Station on a bull breeding PDS.
	(R) Project leader of a collaborative project with the University of Queensland on phosphorus.
	(R) Presenter on future directions in phosphorus research at an MLA meeting.
	(R) Key participant in a collaborative genetics research project with UNE, AGBU, QDAF, UQ and QAAFI.
	(R) Collaborated with Geert Geesink (UNE) on meat quality research.
	(R) Represented DPIF at a Future Directions of Research in Animal Welfare meeting in Sydney.
	(R) Collaborated with the University of Queensland on the use of phosphorus in heifers.
Dionne Walsh	(I) Spelling and stocking rate demonstration trial at Alexandria Station, a collaborative project with the North Australian Pastoral Company.
	(I) Prescribed burning and spelling demonstration trial at Delamere Station, a collaborative project with the Australian Agricultural Company.
	(I) Spelling, stocking rate and infrastructure development demonstration trial at Beetaloo-Mungabroom Station, a collaborative project with the Dunnicliff and Armstrong families and the Barkly Landcare and Conservation Association.
	(I) Benchmarking and on-ground option testing demonstration at Limbunya Station.
	(R) NT project manager for “Northern grazing carbon farming - integrating production and greenhouse gas outcomes (Climate Clever Beef 2)”, a collaborative project with Qld DAFF.
	(R) DPIF representative on the multi-state “Rubber Bush Scientific Advisory Committee”, which includes members of the NT and Qld pastoral industries, Charles Darwin University, Qld DAFF and NT DLRM.
	(R) Contributed to the 2014 Herefords Australia Beef Producers Workshop, Alice Springs, the 2013 Barkly Herd Management Forum, the 2013 North Australia Beef Research Update Conference and the 2013 MLA Beef Up Forums – Mataranka and Adelaide River.

Overseas Travel

Date	Destination(s)	Officer(s)	Purpose
July 2013	Vietnam	Barry Lemcke and David Ffoulkes	Continuing collaboration program with MLA to provide technical support to first-time Vietnamese importers of NT cattle and to assist them to implement the Exporter Supply Chain Assurance System.
August 2013	Cambodia	Brian Thistleton, Cameron McConchie, Bob Williams and Andrew Daly	The inception meeting for theACIAR project HORT 2012/003.
	New Zealand	Austin McLennan, Stuart Smith and Warren Hunt	Christchurch to attend the APEN International Conference.
October 2013	Taiwan	Doris Marcsik	To attend the training and standardisation of protocols of tissue culture and somaclonal variant selection in the Musa Improvement Workshop.
	Indonesia	David Ffoulkes and Scott Wauchope	Nusa Tenggara Timur region - 15-22 October 2013 to participate in an NT Cattlemen's Association -led delegation to explore business development opportunities and participate in industry engagement in the region.
	The Philippines	Mark Hoult	As part of the ACIAR Tropical Fruits Project
November 2013	China	Scott Wauchope	Agricultural program from 30 October to 9 November 2013 to attend high-level meetings in Shanghai and Beijing to develop a relationship between the NT Government and the Chinese Government and to meet food export and agricultural industries members.
	Indonesia	Kieren McCosker	Attend the final project meeting for an ACIAR project.

Overseas Travel

Date	Destination(s)	Officer(s)	Purpose
November 2013 cont.	Timor Leste	Steve Davis, Suresh Benedict, Cathy Shilton, Lorna Melville and Neville Hunt	To provide laboratory training to staff of the Ministry of Agriculture and Fisheries' Veterinary Laboratory.
	Cambodia	Brian Thistleton	As part of an ACIAR project to conduct a mango pest and disease workshop and establish a pheromone trial for ACIAR project HORT 2012/003.
	New Zealand	Lucy Tran-Nguyen	Auckland to attend the 19th Biennial Australasian Plant Pathology Conference.
	China, Indonesia	Bob Williams	Attend the 5th China – Australia workshop on horticultural cooperation on technical exchange and production-marketing matchmaking of horticulture products in Beijing on 27 November 2013. Also to participate in an ACIAR project review on banana wilt in Jakarta.
December 2013	Timor Leste	Malcolm Anderson	To attend a final workshop related to the AusAid-funded Ministry of Agriculture and Fisheries Veterinary Laboratory Project, 3 and 4 December 2013.
February 2014	Vietnam	Barry Lemcke and David Ffoulkes	To Dak Lak, Hai Phong, Bien Hoa and Ho Chi Min City - 15 - 25 January 2014. DPIF/MLA Vietnam Supply Chain Assistance Project (2013-14) - Second of eight visits.
March 2014	Cambodia	Andrew Daly, Cameron McConchie and Brian Thistleton	As part of an ACIAR Project HORT 2012/003.
	Thailand	David Frost	To attend the Meat and Food Safety Focus Asia 2014 Conference, Bangkok.

Overseas Travel

Date	Destination(s)	Officer(s)	Purpose
March 2014 cont.	Vietnam	Scott Wauchope and Jenny Hill	To report on the buffalo industry delegation the Minister led to Vietnam to demonstrate high level NT Government support for the live export industry, to further develop the relationship between the NT Government and Vietnamese importers of NT livestock and to specifically introduce NT buffalo industry representatives to Vietnamese importers of NT buffalo and those interested in importing NT buffalo.
	Tim Schatz	Indonesia	To Lampung 12 to 15 March 2014 to collect data as part of a cattle research project at the Elders feedlot in Lampung.
May 2014	Timor Leste	Lorna Melville, Steve Davis and Neville Hunt	Continuing laboratory training at the Timor-Leste Ministry of Agriculture and Fisheries Veterinary Diagnostic Laboratory as a follow up to work conducted under FAO's Biosecurity Strengthening Program .
	China and Vietnam	Scott Wauchope, David Ffoulkes and Jenny Hill	A supply chain tour in collaboration with the NT Cattlemen's Association, 10 to 22 May 2014.
	Timor Leste	Steve Davis	To install a microscope.
	The Philippines	Mark Hoult	As part of an ACIAR project (27 May to 7 June 2014) to assess project capacity post typhoon Haiyan and implement project activities, specifically nursery production systems for disease free propagules.
June 2014	Timor Leste	Neville Hunt	To commence a cold chain monitoring project for vaccine distribution as part of an AusAID project.
	Thailand	Cathy Shilton	To Mahidol University, near Bangkok, 19 - 22 June 2014 as a representative of the NT Government and the NT crocodile industry to establish research links.

Seminars and Lectures

Date	Officer	Seminar/Lecture
July 2013	Austin McLennan	Fruit flies, mangoes and market access: The story so far
August 2013	Prof. Acelino Alfenas (visitor)	1. Ceratocystis wilt of eucalyptus and mango trees cause by *Ceratocystis fimbriata* s.l. 2. Myrtle rust: a disease of intercontinental interest
August 2013	Dr Jeff Daniells (visitor)	The basics of banana identification
August 2013	Grant Johnson	Blacktip sharks: Spot the difference
September 2013	Dr Dionne Walsh	Is there a business case for NT cattle producers to “farm carbon”?
November 2013	Dr Robert Barigye	Bovine ephemeral fever

Publications

Scientific Papers, Peer reviewed and other Publications.

Ash, A., Hunt, L., McDonald, C., Scanlan, J., Bell, L., Cowley, R., Watson, I., McIvor, J. and MacLeod, N. (2013). Innovation and investment to boost productivity and profitability for the northern beef industry – what are the opportunities? *In*: Proceedings of the Northern Beef Research Update Conference, August, Cairns.

Barigye, R., Davis, S., Day, C., Burnurp, C., Walsh, S. and Melville, L. (2013). Immunohistochemical detection of bovine ephemeral fever virus antigens in bovine tissues. Oral presentation and abstract. *In:* Proceedings of the Australian Society of Veterinary Pathologists Annual Conference, 11-13 October, 2013.

Barigye, R., Burnup, C., Davis, S., Aumann, S., Day, C., Walsh, S. and Melville, L. (2014). Kinetics of pro-inflammatory cytokines and persistence of viral RNA and antigens during natural bovine ephemeral fever infection . Accepted for oral presentation. *In:* The XXVIII World Buiatrics Congress in Cairns, Queensland, 27 July to 1 August, 2014.

Barigye, R., Burnup, C., Davis, S., Aumann, S., Day, C., Walsh, S. and Melville, L. F. (2014). Immuno-histochemical detection of bovine ephemeral fever virus antigens in bovine tissues. Oral presentation at the *Knowledge Seminars* of the Department of Primary Industry and Fisheries. Abstract available online at: http://www.dpif.nt.gov.au/knowledgeseminars

Cameron, A. and Walsh, D. (2014). The value of grazed grass pastures in the Katherine region. *Katherine Rural Review* 2014: 6.

Collier, C. and Walsh, D. (2013). Wet season spelling at Alexandria Station, Barkly Tableland, p. 125 *In*: Proceedings of the Northern Beef Research Update Conference. (North Australia Beef Research Council: Gympie Qld).

Coventry, J. (2013). Managing plant poisoning in cattle - (Information Sheet), *Alice Springs Rural Review*, **53:**12.

Coventry, J. (2013). Review of aspects of breeding herd performance from beef cattle projects on the arid rangelands of the Alice Springs district, Master's thesis by research, Murdoch University, (online) available at: http://researchrepository.murdoch.edu.au/18322/.

Coventry, J. (2014). Benefits of HGP-use and MSA-grading – a pilot cattle study in the Alice Springs district, part 1, *Alice Springs Rural Review* **56:** 9-10.

Coventry, J. (2014). Benefits of HGP-use and MSA-grading: Pilot cattle study in Alice Springs district, part 2, *Alice Springs Rural Review* **57:** 9-10.

Coventry, J. (2014). Remote technologies for cattle recording – International Conference Report, *Alice Springs Rural Review* **57:**4.

Coventry, J. (2014). Remote technologies improve records of reproductive performance for extensively-grazed beef cows. *In*: Proceedings of the XXVII World Buiatrics Congress, Cairns: Oral communication and poster abstracts, pp. 219-20, D.S. Beggs (ed.).

Coventry, J. (2014). Report on a minor project activity: The effect of using hormonal growth promotants in cattle with regards to the net profit for cattle marketed from the Alice Springs district and graded at abattoirs by Meat Standards Australia, Pastoral Production, Alice Springs. DPIF Internal Report.

Coventry, J. and Gill, B. (2014). Weaning — a demonstration of options for best practice, *Alice Springs Rural Review* **55:**12-14.

Cowley, R. A., Cowley, T. M., Hearnden, M. H. and Pettit, C. L. (2013). Early dry season or two-yearly fires are not so hot in grazed savannas: fire impacts on pasture species. *In:* 'Northern Beef Update Conference'. pp. 21-26. (North Australia Beef Research Council, Cairns).

Cowley, R.A. and Jenner, D. (2013). Conservation and Indigenous land burns too much and pastoral land not enough in the Victoria River District, but it depends on land type. *Katherine Rural Review*, **316:**6, December. Available at http://www.nt.gov.au/d/Content/File/p/NL/316_14_krr.pdf

Cowley, R. A., White, I. A., Hearnden, M. H., Leigh, P., Hunt, S., Petty, P. and Symes, L. (2013). Do multi-paddock systems increase evenness of grazing at the paddock scale? In revitalising grasslands to sustain our communities" *In*: Proceedings of the 22nd International Grassland Congress: www.igc2013.com. pp. 938-939.

Cowley, R. A. and Walsh, D. (2013). Stocking rate – the missing link in multi-herd cattle production studies? *In*: Proceedings of the Northern Beef Research Update Conference, August, Cairns.

Cowley, R. A., Hearnden, M. H. Pettit, C. L. and Cowley, T. M. (2014). How hot? How often? Getting the fire frequency and timing right for optimal management of woody cover and pasture composition in northern Australian grazed tropical savannas. Kidman Springs fire experiment 1993-2013. *The Rangeland Journal* (in press).

Dollemore, W. and McGowan, M. (2013). Phosphorus supplementation and adequacy: Distribution of case studies across northern Australia. *In*: Proceedings of the Northern Beef Research Update Conference, 12-15 August, Cairns Qld, p. 164.

Dollemore, W., Quigley, S., Poppi, D. and McCosker, K. (2013). Change in live-weight of non-pregnant, mature Bos indicus cows of different lactation statuses over the dry season. *In*: Proceedings of the Northern Beef Research Update Conference, 12-15 August, Cairns Qld., p. 163.

Douglas, J. (2013). Making production and conservation gains through adaptive grazing at Beetaloo Station pp. 24-25, Barkly Herd Management Forum, 2013 Handbook.

Douglas, J. and McMillan, H. (2013). Barkly Herd Management Forum. Final Report to Meat & Livestock Australia E.INS.1339, 18 pp.

Douglas, J., Walsh, D., Wilson, N. and Armstrong, J. (2013). Improving performance through adaptive grazing – Beetaloo Station, p. 130 *In*: Proceedings of the Northern Beef Research Update Conference. (North Australia Beef Research Council: Gympie Qld).

Eagles, D., Melville, L., Weir, R., Davis, S., Bellis, G., Zalucki, M. P., Walker, P. J. and Durr, P. A. (2014). Long-distance aerial dispersal modelling of *Culicoides* biting midges: case studies of incursions into Australia. *BMC Vet Research* **19:**10:135.

Fordyce, G., McCosker, K. D. and McGowan, M. R. (2013). Advances in reproductive management of cow-calf nutrition in times of crises. *In*: VIII Jornado NESPRO: International Symposium on Beef Cattle Production Systems, Porto Alegre, RS, Brazil, 24-26 September.

Fordyce, G., McCosker, K., Smith, D., O'Rourke, P., Perkins, N. and McGowan, M. (2013). Performance and production of north Australian beef breeding herds - Findings from The CashCow project. *In*: Proceedings of the Australian Cattle Veterinarians 2013 Conference. Australian Cattle Veterinarians 2013 Conference, Darwin, Australia, (105-111) 25 to 28 June.

Fordyce, G., McMillan, H. and McGrath, N. (2014). Accelerating healing of calf frontal sinuses exposed by dehorning. Final Report to Meat & Livestock Australia.

Gu, X., Davis, R. J., Walsh, S. J., Melville, L. F. and Kirkland, P. D. (2014). Longitudinal study of the detection of bluetongue virus in bull semen and comparison of real time polymerase chain reaction assays. *Journal of Veterinary Diagnostic Investigation* **26(1):**18-26.

Leigo, S. (2013). Precision Pastoral Management Tools Project Policy Briefing, Ninti One Limited, Alice Springs. View here: Policy brief

Leigo, S. (2013). Shifting into the driver's seat – Building the leadership capacity of Australia's cattlewomen. *Rangelands* **35:** (6) 68-74.

Leigo, S., Brennan, G., Beutel, T., Gray, A., Phelps, D., Driver, T. and Trotter, M. (2013). Harnessing technologies for the beef industry of remote Australia. *In*: Proceedings of the Northern Beef Research Update conference, North Australia Beef Research Council, Gympie.

Leigo, S. and Oxley, T. (2013). A woman's capacity – grass roots development of cattlewomen as leaders. *In*: Proceedings of the northern beef research update conference, North Australia Beef Research Council, Gympie.

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