final report

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PDSNT003 – A practical demonstration of the Polled Gene Marker Test to increase the frequency of polled progeny and use of fixed time artificial insemination in commercial Northern Territory beef herds

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Executive summary

In the northern NT Brahman is the major cattle breed due to its heat tolerance, parasite resistance and hardiness, making up 78% of cattle in the Katherine region and 83% of cattle in the Top End region (Cowley *et al,* 2014). The Brahman breed is predominantly horned, with Prayaga (2005) estimating that only 10% of Brahmans were naturally polled or scurred. Due to the nature of extensive beef production in northern Australia, animals typically are not dehorned until they are weaned (between 3 – 10 months old) which has animal welfare implications (Petherick, 2005).

Increasing the frequency of the polled trait in tropical breeds in northern Australia has positive implications for animal welfare, productivity, labour requirements and safety of station staff. There are three major strategies through which commercial breeders can increase the frequency of phenotypically polled animals in their herd:

- Purchasing polled Brahman bulls to be mated to their commercial herd
- Crossbreeding their commercial herd with a tropically adapted polled breed
- Create an on-station nucleus bull breeding herd due to the low availability of high quality polled genetics within the Brahman herd

Sourcing high quality Brahman polled genetics can be difficult for northern beef producers due to the low incidence of polledness in Brahmans. Although crossbreeding is increasing in popularity many producers are concerned that this may limit live export market options or result in price penalties as crossbred stock based on prior experience in the market. The third option formed the basis of this Producer Demonstration Site.

With the recent release of the polled gene marker test, the ability to differentiate between homozygous (carrier of two copies of polled allele) and heterozygous (carrier of one copy of polled allele) polled animals is now possible. Homozygous polled sires provide a more rapid rate of infusion of the polled gene into a Brahman herd, with >85% polled/scurred progeny when mated with horned cows compared to 50% polled/scurred progeny using a heterozygous sire.

Lakefield Station and Avago Station located on the Sturt Plateau in the Katherine region were already committed to breeding for polledness. After experiencing difficulty identifying and accessing affordable and fertile polled Brahman bulls, both stations became part of this Producer Demonstration Site. The aims of this Producer Demonstration Site were to demonstrate how the polled gene marker test could be used to identify stock that meet breeding objectives, how fixed time artificial insemination (FTAI) can be used to gain access to a wider range of genetics, and the effects of using true polled bulls (PP) on the proportion of polled offspring versus using PH bulls that appeared polled but were actually heterozygous for this trait. As a result of this PDS the two families involved believe that the Polled Gene Marker Test can offer value to their bull breeding herds and will not purchase sires without being tested prior. Poor FTAI success meant that one family was further discouraged from using AI in their stud herd, while the other still saw great value that AI could offer to genetic progress in their bull breeding herd, and was still committed to utilising the practice in the future

As part of this PDS, four field days were held featuring the experiences and results from both sites. One hundred and twenty beef producers, industry representatives and veterinarians attended these field days that were held in four loactions across the NT. An increased intent to practice balanced selection using objective data when purchasing bulls were very positive outcomes of these days, along with increased awareness and intent to use the Polled Gene Marker Test.

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1 Background

1.1 Value of polledness

Polledness is a valuable trait in cattle as it reduces the risk of injury to stockhandlers and other cattle. The elimination of horns reduces the incidence of bruising during transport which in 2009 was estimated to cost the beef industry $22.5 million annually (Prayaga, 2005). Furthermore, polledness prevents the need to dehorn which is a labour intensive practice that can have negative implications for animal welfare and productivity. For example, 2% higher mortality rates were observed in calves that were dehorned compared to polled calves which were not dehorned in the Beef CRC II project (Bunter et al., 2014). Dehorning is a routine practice in the northern NT as the cattle herd is predominantly horned, with 80% being Brahman cattle (Cowley et al., 2014) of which an estimated 90% are horned (Prayaga, 2005). Due to the nature of extensive beef production, animals are typically not dehorned until they are weaned (between three and ten months old) which has animal welfare implications (Petherick, 2005). Increasing the frequency of the polled trait in tropical breeds in northern Australia has positive implications for animal welfare, productivity, labour requirements and safety of station staff.

1.2 Inheritance of polledness

The polled gene has two forms; polled (P) or horned (H). Every animal has two copies of the polled gene, indicating that an animal could potentially be PP, PH or HH. An animal that has two of the same copies of the polled gene (e.g. PP or HH) is referred to as homozygous or true polled, while an animal that has one of each form of the gene is heterozygous (e.g. PH). About 99% of PP Brahmans are polled, while PH animals can either be polled, scurred or in some cases, horned. HH animals are horned.

An animal gets one copy of the polled gene from its mother and one copy from its father, and consequently randomly passes on one of its copies to its progeny. PP animals are considered “true polled” as they pass on the polled copy to 100% of their progeny. However, PH animals are carriers of horn, and will only pass on a polled copy to half of their progeny. Therefore, using PP sires in preference to PH sires will speed up the time taken to reach a polled herd. Homozygous polled sires provide a more rapid rate of infusion of the polled gene into a Brahman herd, with >85% polled/scurred progeny when mated with horned cows compared to 50% polled/scurred progeny using a heterozygous sire. Since PP and PH animals can both present as visually polled, it is desirable to be able to distinguish between them.

1.3 Australian Polled Gene Marker Test

With the recent release of the polled gene marker test, the ability to differentiate between homozygous and heterozygous polled animals is now possible through a simple tail hair sample. The Poll Gene Marker test determines the poll genotype of an animal. That is, whether they are true polled (PP) or carriers of horns (PH). The test uses gene markers which are fragments of DNA that are not directly responsible for polled status, but are closely associated with the polled gene.

The Polled Gene Marker Test was updated in 2014 with an increase in the percentage of informative results provided by the test for the Brangus, Charolais, Droughtmaster, Hereford, Limousin, Santa Gertrudis, Simmental and Shorthorn breeds. The test already worked well in the Brahman breed.

Within the Brahman breed, validation studies showed the proportion of scurred, horned and polled animals within each genotype. Scurred animals predominantly had a PH genotype, while polled animals could either be PP or PH, and sometimes HH.

Table 1: Percentage of Brahmans tested within the Polled Gene Marker validation studies that were visually polled, scurred or horned

Genotype	Visual Appearance		
	Polled (%)	Scurred (%)	Horned (%)
PP	98	1	1
PH	40	50	10
HH	2	6	92

1.4 Breeding for Polledness: practical considerations

There are three major strategies that northern Australian commercial breeders can use to increase the frequency of phenotypically polled animals in their herd:

- Crossbreeding their commercial herd with a tropically adapted polled breed (eg Senepol)
- Purchasing polled Brahman bulls to be mated to their commercial herd
- Breeding polled sires using a nucleus herd on-property

The first strategy is well known and its demonstration is currently being undertaken at Victoria River Research Station by NT DPIR. While the progeny from a crossbreeding system have the potential of increased marketability, it requires a change in the well engrained breeding strategy of using purebred Brahman sires.

At present, due to the low prevalence of phenotypically polled animals in the national Brahman herd, estimated at 10% (Prayaga, 2005), purchasing the required numbers of polled bulls to be mated to a commercial herd is logistically impracticable as they are difficult to source and expensive due to the current premiums being paid for polled sires. These sourcing difficulties are further amplified where bulls are selected on performance traits as well as polledness.

Logistically, it could be argued that breeding polled sires using a nucleus herd on-property would be the most efficient strategy to increase polledness within a commercial herd. Practically, this could be achieved by purchasing fewer but superior sires and naturally mating, through the use of artificial insemination (AI), or a combination of both. One of the benefits of using artificial insemination over purchasing polled sires to be mated to a nucleus herd is that AI enables the use of a larger number of sires with excellent fertility traits, increasing the genetic variation of the progeny and therefore selection potential in identifying potential future sires. For the purposes of this project, fixed time artificial insemination (FTAI) was used due to the large capital purchase required to obtain superior polled sires fit for a natural mating system.

2 Project objectives

By 30th December 2014:

- To demonstrate the practical application of the Polled Gene Marker Test for breeding home grown homozygous polled bulls for own use in high-grade Brahman commercial herds on two NT properties.
- To demonstrate the increased number of polled and scurred progeny when using tested PP versus tested PH bulls over HH cows.
- To demonstrate the use of fixed time artificial insemination on two NT herds as per best practice.

This project aimed to demonstrate the use of the Polled Gene Marker Test to breed polled sires on-property using a nucleus herd as well as demonstrating that the use of PP over PH sires (as distinguished by the Polled Gene Marker Test) will yield more phenotypically polled progeny. Further, AI is a technology that has the potential to increase the infusion of highly desirable genetic material in the northern beef industry. However, it is not a widely adopted practice. Therefore, this project also aimed to demonstrate the use of FTAI as per best practice in NT breeding herds.

A balanced, multi-trait selection is critical in any sustainable breeding objective. Hence, this project advocated the selection of sires using multiple traits and structural fitness, not just selection for polledness.

3 Methodology

3.1 Site descriptions

Both properties were located in the Sturt Plateau district in northern NT, which experiences a subtropical climate, with distinct wet and dry seasons and a median rainfall of 553mm at Daly Waters (50km east of Avago Station) and 678mm at Mataranka (30km north east of Lakefield Station). Both families breed high grade Brahman cattle, targeting the feeder steer live export market. Lakefield and Avago Stations currently breed a number of the bulls used in their commercial herds and have recently been investing in polled genetics. As a result of this investment, phenotypically polled bulls and breeders are present in their stud and commercial herds.

Garry and Michelle Riggs own and operate Lakefield Station. The Riggs have been investing in polled genetics since the mid-2000s. They decided to move towards a polled herd for a number of reasons; better welfare for the animals, better production through minimising the post-weaning growth setback and to meet future animal welfare expectations of the broader community. The ultimate goal is to produce a polled Brahman breeder herd. They have a small bull breeding herd to produce polled bulls due to the limited availability of polled Brahman bulls.

Keith and Roxie Holzwart own and operate Avago Station. Like the Riggs, Keith and Roxie started breeding polled animals a number of years ago. Their ultimate goal is to breed PP bulls for use in their commercial breeding operation. Their decision to move towards polledness was based on the desire to meet their own and society's animal welfare expectations. They believe that balanced selection is critical; with fertility, structural soundness and temperament also ranking very highly in their selection criteria along with polledness. They have found it very difficult to purchase the type of bull that fits these criteria.

3.2 Part A: Using FTAI to breeding polled bulls in nucleus herds

FTAI programs using PP semen were conducted in selected females from the stud herds at Lakefield Station in April 2012 and at Avago Station in December 2012. Sourcing PP semen was difficult as there were very few PP sires to choose from and most were from one stud, therefore offering limited genetic variation. Only five studs were identified that had been breeding polled Brahmans over a significant period of time. To complement the use of FTAI programs, the Polled Gene Marker Test was used to identify homozygous polled mop-up bulls.

Both the Riggs and the Holzwarts were concerned about the logistical difficulty of conducting an AI program using wet cows. The families decided to select breeders that had produced two weaners in consecutive years, but were pregnancy tested as empty at weaning in the second round of 2011. Within these, polled and scurred animals were selected preferentially. Polled and scurred heifers were also preferentially selected to enter the AI program.

Progeny and dams were Poll Gene Marker tested and visually phenotyped. Progeny were mothered up at Lakefield, but not at Avago.

A cost analysis compared the costs of breeding the selected home-bred sires through AI, compared with purchasing polled sires at market value for the Avago herd. This was carried out by Fred Chudleigh of DAFF.

3.3 Part B: PP vs PH sires over horned females comparison

The proportion of polled, scurred and horned progeny was compared between the matings of PP versus PH bulls over horned females at Avago Station.

PH bulls (Brahmans) were mated to 700 commercial heifers in December 2012. The PH bulls were a mix of home bred and bought bulls. They underwent a Bull Breeding Soundness Evaluation prior to mating to ensure they were reproductively fit. There were some polled and scurred heifers in the mob due to the progress Avago had already been making towards a polled herd. At weaning in June 2014, scurred and polled heifers and their progeny were cut out from the larger heifer mob and not included in the analysis. The progeny from the remaining mob of horned heifers were assessed for poll/horn phenotype. Based on the science, it was expected that 50% of progeny would be PH and 50% would be HH – which meant that roughly 20% would be visually polled, 30% scurred and 50% horned based on the Polled Gene Marker validation data (Emily Piper, pers. comms).

PP bulls (Senepols) were mated over the same time period to an older stud mob of largely horned cows. Out of 53 cows, 5 were polled and 1 was scurred, while the rest were horned. At weaning in 2014 the dams and calves were visually assessed for their horn status but not mothered up, which meant that the progeny from the polled and scurred dams were not removed from the sample as they were not identified as had occurred with the hiefers. This would have slightly elevated the proportion of polled and scurred progeny expected from a straight PP x HH mating. For a straight PP by HH mating it was expected that all progeny would be PH – which meant that roughly 40% would be polled, 50% scurred and 10% horned based on the Polled Gene Marker validation data (Emily Piper, pers. comms).

3.4 Animal Ethics

Animal ethics approval for this project was obtained from the Charles Darwin University Animal Ethics Committee.

4 Results

4.1 Part A: FTAI programs

Lakefield Station:

Table 2 shows the average weight, body condition score and number of females identified as FTAI candidates in January 2012. They put on an average of 20kg between January and the start of the FTAI program in late March.

Table 2: Weight and body condition scores of FTAI candidates in January 2012

Class	Av weight (kg)	Av BCS (1-9)	N
Breeder	394	5.6	32
First calf heifer	320	6.0	8
Maiden Heifer	284	5.6	23
Grand Total	**344**	**5.6**	**63**

At pregnancy testing in November 2012 90% were pregnant, 6% were empty and 4% were not preg-tested (mis-mustered).

At bull removal in May 2013 there was a 79% calving rate and 14% calf loss. Based on parentage testing, it was determined that 11 calves were progeny from the AI program (24% success). This was lower than expected. Nutrition/body condition are key determinants of success in AI programs. There were 15 two year old heifers that averaged 325kg at insemination. Of these only one heifer had an AI calf (see Figure 1). It is likely that some of these heifers were not yet pubertal. The age group that had the highest AI success were four year old heifers, which were in the best condition having had a year off after failing to reconceive after their first calf.

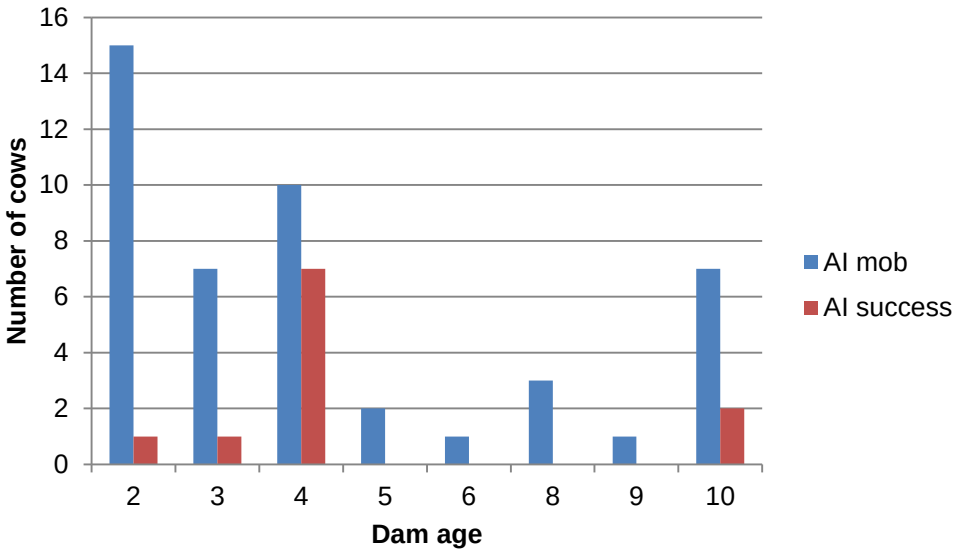

Figure 1: Age distribution of AI mob and of cows which had a successful AI pregnancy

Table 3 shows that the females that had a successful AI pregnancy were heavier on average than those that did not, though the sample size is small and slightly confounded by age.

Table 3: Average pre-AI body condition score and weight of cows which had a successful AI pregnancy and those that did not

Successful AI pregnancy	Av. BCS pre-AI (1-5)	Av. weight pre-AI (kg)
No	3.6	362
Yes	3.5	380

Lakefield genotype and phenotype results:

Calves were four months and younger in age, with some likely to be only two months old when they were mothered up and their phenotype was assessed. This is normally too young to assign phenotype as the horn structure is still developing at this age. Based on this, the progeny from the AI mob were 70% polled and 30% were scurred. Of the larger mob (AI mob and extra 9 calves from stud mob which were also mated to PP sires), 67% were polled, 33% were scurred.

Genotype testing revealed that 70% were heterozygous polled (PH), 18% were homozygous polled (PP) and 11% were not able to be determined. Table 4 shows the relationship between genotype and assigned phenotype in the progeny. Of the 31 PH calves, 61% were called polled and 39% were called scurred. This is higher than expected, and it is possible that due to the young age of the progeny that errors were made when assessing phenotype. One hundred per cent of the PP progeny were assessed as phenotypically polled.

Table 4: Correlation between genotype and assigned phenotype in 45 progeny from PP sires

Assigned Phenotype	Progeny Genotype			
	HH	PH	PP	Not determined
Horn (N)				
Poll (N)		61% (19)	100% (8)	80% (4)
Scur (N)		39% (12)		20% (1)
Total (N)		100% (31)	100% (8)	100% (5)

To look at the data from another angle, of the polled calves, 12% returned a not able to be determined genotype, 61% were PH and 26% were PP. Of the scurred progeny, 92% were PH and 8% were not able to be determined.

It was difficult to assign phenotype to the dams as many had been dehorned as calves or weaners. This can been seen in Table 5 where some HH animals were called polled and some PP animals were called horned.

Table 5: Relationship between assigned phenotype and genotype in dams

Assigned Phenotype	Dam Genotype			
	HH	PH	PP	Ambiguous
Horn (N)	86% (18)		9% (2)	5% (1)
Poll (N)	20% (2)	10% (1)	70% (7)	
Scur (N)			100% (3)	

Table 6 shows the percentage of progeny of different poll/horn genotypes that were from dams of different poll/horn genotypes. Results are largely as expected. Ninety-five per cent of HH dams had a PH calf, while 1 had an ambiguous genotype calf. From a PH by PP mating you would expect 50% PP progeny and 50% PH progeny. This mob had 54.5% PH and 45.5% PP, which was no doubt due to a low sample size (N=11).

Table 6: Percentage of poll/horn genotype in progeny from dams of certain poll/horn genotypes

Calf genotype	Dam genotype			
	Ambiguous	HH	PH	PP
Ambiguous	50% (1)	5% (1)		
PH	50% (1)	95% (19)	54% (6)	
PP			45% (5)	100% (1)

The key result for Garry and Michelle was that as a result of using all PP sires over their stud herd (AI and mop up sires), they did not have a single calf to dehorn as 67% were polled and 33% were scurred.

There was a gender difference in the proportion of scurs, with a higher proportion of scurs occurring in the PH males compared to PH females. While PH males were 50% polled and 50% scurred, 75% of PH females were polled and only 25% were scurred. There was no gender difference in the proportion of scurs in PP animals as all animals were polled.

Avago:

Unfortunately the AI success rate was very poor, with only seven AI progeny (nine per cent AI success). The AI technician believed that the heifers had not come on properly at the time of insemination, which he believed was related to the fact that the wet season hadn't broken as had been expected, hence the cattle were not on a rising plane of nutrition at the time of insemination. In terms of phenotype proportions in progeny when using PP sires, Keith and Roxie got a good result, with 78% polled and 22% scurred progeny – no horned calves.

There was a gender difference in the proportion of scurs. While all female PP progeny were polled, 15% of male PP progeny at Avago were scurred. There was also a greater proportion of PH male progeny with scurs compared to female progeny. While PH male progeny were evenly split between polled and scurred, 70% of PH females were polled and only 30% were scurred.

Cost analysis of home bred bulls

Two economic models of the Avago beef business were compared. One with home bred bulls (current) and one without (new). The major assumptions that differentiated these two scenarios were:

- Slightly higher mortality/breakdown in purchased bulls (1% higher) in new scenario
- Under their current management system, Avago sell home bred bulls after 2 years of use to other commercial producers to use as breeding bulls for about $1000/head. In the new scenario the Holzwart's assumed that if purchasing bulls they would keep the bulls until 8 and then sell into the live export market for about $720 (600kg @ $1.20/kg)
- Purchase price of bulls was assumed at $3000 in new scenario
- A labour saving of $20,000/year if not running the stud herd in the new scenario

Based on these assumptions, it was calculated that Keith and Roxie were $20/AE better off breeding their own bulls, compared to purchasing bulls. This equated to an extra $2mil over a 10 year period.

The major factor driving the profitability of this scenario is the assumed high price of purchased bulls in the "New" scenario, and the high sale price of culled herd bulls in the "Current" scenario. If Keith and Roxie sold all of their cull bulls to the abattoirs and purchased industry standard price bulls (i.e. around $2250/head), then the profitability of breeding their own bulls compared to not would be greatly reduced, but still slightly more profitable. Currently this is not an option for Keith and Roxie as they cannot purchase the bulls they want for their herd, so have resorted to breeding their own.

4.2 Part B: PP vs PH comparison

It was expected that all progeny from PP bulls would be PH – which means that roughly 40% should be polled, 50% scurred and 10% horned. Of 53 cows in the PP versus PH comparison, 5 were polled and 1 was scurred, which led to more polled/scurred progeny than expected. Sixty-two per cent of progeny were polled, 23% were scurred and 15% were horned (Table 7). Interestingly, the proportion of scurs was significantly lower, something which Roxie also commented on compared to previous Senepol x Brahman matings.

In the PH herd, it was expected that, 50% of progeny would be PH and 50% would be HH, meaning that approximately 20% would be polled, 30% scurred and 50% horned. Instead, 39% polled, 22% scurred and 40% horned. As it is difficult to differentiate between a horned and a scurred weaner due to the age at weaning and the nature of horn development, it is assumed that scurred calves are often dehorned. When comparing the two mobs, 38% of progeny by PP sires would have been dehorned, compared to 60% of the progeny by PH sires which is a significant difference.

Table 7: The expected and actual proportion of progeny in each phenotype when using PP or PH bulls at Avago

Phenotype	PP Bulls		PH Bulls	
	Expected (%)	Actual (%)	Expected (%)	Actual (%)
Poll	40	62	20	40
Scur	50	23	30	22
Horn	10	15	50	38

4.3 Lakefield Field Day

On the 5th of July 2014 a field day to present the PDS results was held at Lakefield Station in conjunction with the local natural resource management group, Roper River Landcare Group Inc. A range of topics were covered (see
Table 8).

Table 8: Average ratings for presentations at the Lakefield Field Day

Presentation	Average rating (out of 10)
Value of Natural Resource Management – Karen May	7.0
Agile Wallaby Project – Miguel Bedoya	7.8
Aim, fire, recalibrate: Hitting your breeding target – John Bertram	7.8
The Power of BREEDPLAN – John Bertram	7.8
Breeding the horns off your herd – Trisha Cowley	7.9
Polled PDS results – Trisha Cowley	8.1
Using the Polled Gene Marker Test to breed polled bulls – Garry Riggs and Keith Holzwart	7.9
Breeding balanced bulls at Lakefield Station – Garry Riggs	7.9
Breeding balanced bulls at Avago Station – Keith Holzwart	8.1
Planning AI programs for success in the NT – Geoff Niethe	8.2
Selecting structurally and reproductively sound bulls – John Bertram	8.3
ReproScan demonstration	8.9
Producer talks	8.9
Station tour	8.2

In total 68 people attended the day, of which the large majority were producers (46) as seen in Figure 2.

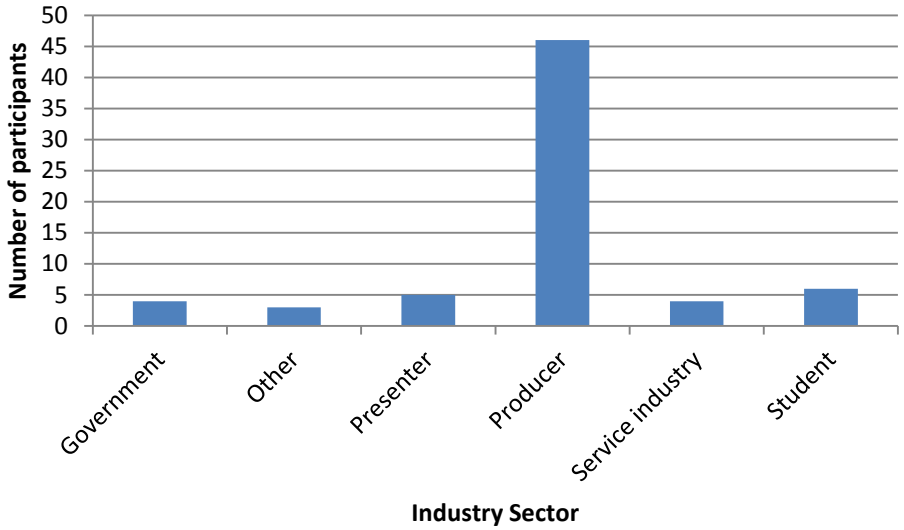

Figure 2: Breakdown of field day participants by industry sector

Of the 22 attendees who filled out an evaluation form, 95% felt that they had learnt something new that day, but only 55% thought that it had changed what was possible to achieve in their business. Fifty-nine per cent were interested in attending more training as a result of attending the field day. While 41% planned to make changes, 18% did not and 32% weren't sure.

Some of the changes mentioned included:

- Plan to use great care when selecting bulls
- Continue to improve fertility in our herd to improve northern beef industry
- More analysis of bull data
- More attention to bull selection
- Slight modifications to bull breeding assessments
- Look into ReproScan
- More selection pressure on bulls, especially regarding morphology and poll status
- We may change some emphasis of bull selection. We are already breeding for polledness, but the cost and uncertainty of the gene test for Droughtmasters deters us
- The field day just reinforced the changes we are trying to make.
- Tweak the selection criteria for home bred bulls (at least)

4.4 Bull Selection and Polledness Field Day Roadshow

The 2015 Bull Selection and Polledness Field Day Roadshow was a series of three field days throughout the NT that made the most of having genetics and fertility experts John Bertram and Zoetis' Technical Manager of Genetics, Emily Piper, in the NT. The roadshow began in Alice Springs on 15 September with 12 producers attending from eight local stations. Four of these stations were already consciously making an effort to source polled genetics with three stations indicating that they would utilise the Polled Gene Marker Test when purchasing new bulls as a result of attending the field day. The roadshow moved on to Helen Springs on 16 September, which had 18 participants including two practicing and well respected veterinarians. At the start of the day when participants

were asked to rank their selection criteria when buying bulls, none of the participants mentioned polledness, however at the end of the day when the same participants were asked "Where would you start/continue to change the genetics of your herd?" one station indicated that they would be including the results of a Polled Gene Marker Test from then on. The roadshow presenters then travelled to Montejinni Station in the Victoria River District. This field day attracted 27 participants from 14 stations. These participants were asked the same questions as the previous field day roadshow attendees, with only one station responding that they were currently including polledness in their bull selection criteria. After the presentation, three stations indicated that they would now include it in a balanced criterion along with objective fertility data and conformation when assessing bulls for purchase.

The roadshow structure was flexible, encouraging participants to discuss thoughts and theories amongst themselves while also allowing plenty of opportunity to engage in private conversations with the topic experts and DPIR staff.

4.5 Practice change at Avago and Lakefield

Both families were already invested in breeding for polledness and the PDS provided an impetus to utilise the Polled Gene Marker Technology to a greater extent in their selection process than they would have otherwise. The Holzwarts still believe that FTAI can offer great value to genetic progress in their bull breeding program, and are keen to continue to utilise the technology with improved management practices for better outcomes. However, the Riggs previous poor experiences with AI combined with the poor outcome in this PDS means that they are not interested in undertaking any further AI programs.

Lakefield
In recent years Garry and Michelle at Lakefield Station tried to source only polled or scurred Brahman bulls and have intentionally not purchased horned bulls for eight years. Achieving this has been difficult at times, particularly sourcing true polled sires. Before the release of the Polled Gene Marker Test buying true polled (PP) sires was guess work; not knowing until the progeny dropped as to whether the sire was as advertised. For this reason Garry and Michelle saw the value of the Poll Gene Marker Test and were keen to use it, but being involved in the PDS provided the impetus to get started. Garry and Michelle used the test to make selection decisions in their own bull breeder herd by testing all the sires and using the results to determine which bulls went with which cow group. Superior PP bulls were preferentially mated to the stud herd, while PH bulls that had previously been mated to the stud herd were placed with the commercial cow herd. They also identified any scurred or polled bulls which had a HH genotype and gradually phased these bulls out of the herd over a couple of years. The last horned bulls were sold in 2015, so now all sires used at Lakefield are polled or scurred.

Garry and Michelle tested two year drops of their home bred bulls (2010 and 2011) in 2012, but haven't used the Polled Gene Marker test since in their stud herd. This was due to a number of reasons, partly due to some inconsistencies in test results and partly due to satisfaction with success in the polled proportion of progeny from using visually polled bulls. Some clean polled bulls came back with a HH result, while some obviously horned bulls came back with a PP result which cast doubt on the accuracy of the test for Garry. He understands that the test is now more accurate since its second release and is considering using it again. Furthermore, now that the herd is producing such a high number of polled progeny (approximately 80% of the 2016 weaners which is substantially higher than previous years) Garry believes he will need to use mostly PP bulls to continue the progress of polledness. The reduction in horned progeny is making the branding a lot easier on Garry and the assisting family members.

Garry and Michelle keep approximately 10 bulls out of their stud herd for their own use, and purchase about 10. They make their selection decisions based on what they can visually see, rather than using data. Garry assesses temperament, testicle size, sheath, legs and also semen tests the bulls and refuses to buy a bull without a Polled Gene Marker test result. As a result of Lakefield's ongoing critical selection criteria, the Riggs family have also started selling some polled bulls, as occurred in 2015 with buyers already asking for more. While Garry has offered to Polled Gene Marker test the bulls to prove true polled status, buyers are yet to take up the offer.

Garry's previous experience with AI in northern Australia has not had great success (poor results), and the results of the FTAI in the PDS confirmed his expectations and opinions. He was very happy with progeny from the AI sires, but the low numbers were disappointing for the investment incurred. As a result the Riggs family are not interested in trialling AI again.

Avago

Being involved in the PDS helped cement the belief for Keith and Roxie that balanced selection is critical for genetic progress in all economically significant traits, while single trait selection risks compromising progress in other economically important traits. Keith and Roxie perceive polledness to be important, however this trait ranks lower than temperament, fertility and growth. The Holzwarts would rather use PH bulls that meet their requirements for top priority traits and slow down the genetic progress towards a polled herd, than use PP bulls which have inferior genetic merit for those traits.

When the PDS started Keith and Roxie were already using the Polled Gene Marker Test. By using the test they discovered that the Avago stud herd already contained a few PH animals, however no PP animals. They now use the test as part of their bull selection process and consider it as a very valuable tool. Keith and Roxie use scrotal size at 18mths, weight gain between weaning and 18mths, along with temperament, conformation and the polled genotype in their selection of bulls. Any polled bulls which meet the criteria of the other traits (scrotal size, growth, temperament, conformation) are then polled gene marker tested. The resulting PP bulls are considered the 'cream of the crop' and are mated to stud breeders which provide the replacement heifers for their commercial herd. The polled gene marker test is also used to identify suitable external genetics. In 2015 Keith and Roxie bought six PP and PH bulls to be used in their stud herd which also had above breed average EBVs for fertility and growth traits. They will not buy bulls which have not been polled gene marker tested.

While the FTAI was not a success at Avago, Keith and Roxie still see it as offering a tremendous advantage to their bull breeding herd if they can make it successful, through access to elite genetics and as a means to expanding the genetic variation within their stud herd. Although keen to try an AI program again the Holzwarts want to make sure that they have troublshooted the limitations identified in this current attempt.

The success of this demonstration has provided these beef producers with the confidence in the technology to keep utilising it in order to eventually meet their own animal welfare standards and the expectations of the wider community.

5 Discussion and conclusions

This Producer Demonstration Site had three primary objectives, all of which were achieved between 2011 and 2015. The first objective was to demonstrate the value and practical application of the Polled Gene Marker Test on two commercial cattle stations in the Northern Territory. The owners of the two sites for the demonstration are well respected and innovative Territorians who were already

actively pursuing polled genetics, albeit experiencing difficulty in sourcing the desired article. Previous to the trial at least one of these producers had been acutely misled in the purchase of a bull, leading to a premium price paid for an average product. The demonstration of this technology in action was of great value to these beef producers as they are now have confidence that the genetics they purchase will have a favourable impact on their nucleus bull breeding herds.

At the Lakefield Field Day, which focussed primarily on the results of this PDS, Roxie Holzwart gave a brief presentation during which she stated "The Poll Gene Marker Test has really helped us select bulls for the stud and also certain mobs within our commercial herd. It has taken all the guess work out of that side of the selection process."

The second objective was to compare the speed at which polled genetic gains can be made by breeding 'true' polled bulls with horned cows as opposed to breeding horned and few PH cows with PH bulls. This component of the demonstration occurred at Avago where results were clear and significant – only 38% of the calves from dams that were mated to PP bulls would be in need of dehorning, as opposed to 67% of the calves when mated to PH bulls, saving potential staff injury, time, and likely loss of calf life. Based Bunter et al's (2011) finding of 2% greater calf mortality in dehorned animals, and an assumed calf mortality of 3% in polled animals and 5% in dehorned animals post branding, this would equate to an overall calf mortality of 4.49% in the PH sire mob versus a 3.01% calf mortality in the PP sire mob.

Demonstrating Fixed Time Artificial Insemination (FTAI) was the third objective in this Producer Demonstration Site. The rate of success from this component was unfortunately and unexpectedly low leading to no uptake by the participating stations post trial period. It is presumed the disappointing success rate was due to a failure to meet a number of what turned out to be critical criteria. One such factor was the failure to ensure the heifers in the AI component of the trial were naturally cycling before entering the program. The average weight of the maiden heifers in the Lakefield mob was 284 kg which is short of the average weight at puberty of 335 kg for the Brahman breed, as found by Johnston et al, 2009. Although these weights were recorded in January, and the mob gained an average of 20 kg each in between January and the time of insemination in late March, the average weight of the maiden heifers is presumed to have still been below the average weight at puberty for the Brahman breed, despite being in good body condition.

Another confounding factor may have been the low plane of nutrition the AI females were consuming during the lead up to and during the time of insemination at Avago due to a later than predicted start to the wet season. The AI technician at the insemination event at Avago indicated that it is important, particularly for maiden heifers, to be on a forward plane of nutrition for a period of time before commencing the AI program to ensure a successful response to the hormonal injections.

The overall low success rate of the FTAI component of this PDS is likely to be viewed as a significant barrier of adoption for trial and field day participants, however the learning experience is beneficial to not only the PDS hosts but also the DPIR staff involved.

The Bull Selection and Polledness Field Day Roadshows were well received and provided beef producers the opportunity to hear the results of the Producer Demonstration Sites elsewhere in the NT. Overall, 60 pastoralists and two industry veterinarians attended the field days and were regarded as a success by DPIF. Balanced selection using objective data was a key learning from the field days and a number of producers stated their intention to utilise the Polled Gene Marker Test as a result of attending the field day.

6 Other extension and communication

6.1 Articles

- "Breed the horns out of your herd – understanding the inheritance of horns" – Katherine Rural Review, edition 308, February 2012
- "Breed the horns out of your herd – Part 2: Practical considerations" – Katherine Rural Review, edition 310, September 2012
- "New project demonstrating the practical use of Polled Gene Marker Test" – Katherine Rural Review, edition 311, October 2012
- "NT bull selection roadshow" – Katherine Rural Review, edition 325, December 2015
- "Horns, tail hair and 'second bum holes'" – Central Station http://www.centralstation.net.au/horns-tail-hair-and-second-bum-holes/
- "Polled gene marker test and fixed time insemination producer demonstration sites" – FutureBeef https://futurebeef.com.au/resources/producer-demonstration-sites/northern-territory/polled-gene-marker-test-and-fixed-time-insemination-producer-demonstration-sites/
- "Lakefield Station" Target 100 http://www.target100.com.au/Farmer-stories/Lakefield-Station
- "Breeding polled bulls at Avago Station, Northern Territory", FutureBeef https://futurebeef.com.au/resources/newsletters/futurebeef-ebulletin/breeding-polled-bulls-at-avago-station-northern-territory/

6.2 Presentations

The Kidman Springs Field Day (1 August 2012):
"Breeding the horns out of your herd – Polledness 101 and practical considerations"

Adelaide River (28th August 2013) and Mataranka (30th August 2013) Beef Up Forums: "What's happening locally: Progress on the NT Survey and Producer Demonstration Sites"

6.3 Radio interviews

"Gene test to improve polled cattle selection" ABC Country Hour, 11 November 2013.
"Northern cattle producers turn to polled gene tests" ABC Country Hour, 15 July 2014

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Thanks must also be directed towards Meat and Livestock Australia for funding this Producer Demonstration Site.

9 Appendices

Appendix 1 – FTAI program as advised by Sophia Edwards

Date	Day	Heifers	Dry Cows
	0	Insert 1-Pod Cue-Mate (half device 0.78 g Progesterone) 2 ml Bomerol (2 mg Oestradiol Benzoate)	Insert Cue-Mate (Full device 1.56 g Progesterone) 2 ml Bomerol (2 mg Oestradiol Benzoate) 1 ml Ovuprost (250 µg cloprostenol)
Remove 6am	8	Remove Cue-Mate 2 ml Ovuprost (500 µg cloprostenol)	Remove Cue-Mate 1 ml Ovuprost (250 µg cloprostenol)
Inject 6am	9	1 ml Bomerol (1 mg Oestradiol Benzoate) *(24hrs post Cue-Mate removal)*	1 ml Bomerol (1 mg Oestradiol Benzoate) *(24hrs post Cue-Mate removal)*
Start 12 noon	10	FTAI *(54-56 hours post Cue-Mate removal)*	FTAI *(54-56 hours post Cue-Mate removal)*

Appendix 2 – Lakefield Field Day Program

FutureBeef

Lakefield Station Field Day

Joint field day between DPIF & Roper River Landcare

Register now!

Trisha Cowley
8973 9770
trisha.cowley@nt.gov.au

Michelle Riggs
8978 6448
lakefieldstation@bigpond.com

Lakefield Station
Saturday 28th June 2014

Speakers: **Garry Riggs, Keith Holzwart, Geoff Niethe, John Bertram, Trisha Cowley, Ian Rowbottom**

What's on?

- Update from Roper River Landcare/NRM Board
- Tips to successful AI in northern herds
- BBSE - Selecting sound bulls
- Breeding objectives to guide herd development
- Weighing up home bred bulls vs bought bulls
- Breeding for polledness
- The power of BREEDPLAN
- Results from the Polled Producer Demonstration site at Lakefield and Avago
- Tour of Lakefield

A joint initiative of:

Queensland Government | Northern Territory Government | Department of Agriculture and Food | mla MEAT & LIVESTOCK AUSTRALIA

FutureBeef

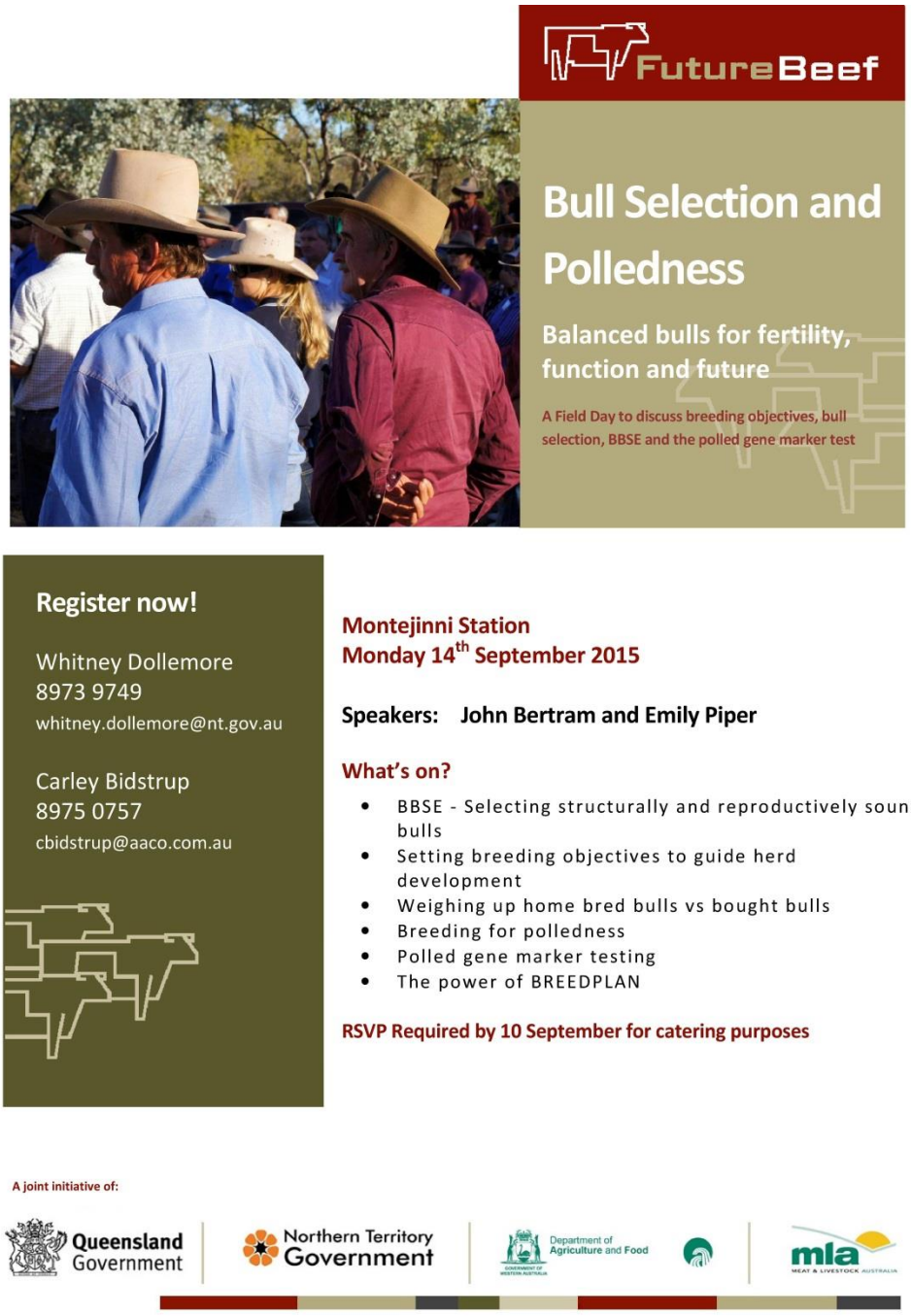
Lakefield Station Field Day

Saturday 28th June 2014

Program

Time:	Session:	Speaker:
9.00am	**REGISTRATION AND MORNING TEA**	
9.30am	Welcome	Garry Riggs
9.40am	Aim, fire, recalibrate: Hitting your breeding target	John Bertram
10.10am	The power of BREEDPLAN	John Bertram
10.40am	Breeding the horns off your herd	Trisha Cowley
11.10am	Polled PDS results	Trisha Cowley
11.30pm	Using the Polled Gene Test – producer insights	Keith Holzwart & Garry Riggs
12.00pm	**LUNCH**	
1.00pm	Tour of Lakefield - Conservation Site, Roper River Landcare update	Garry Riggs & Ian Rowbottom
2.30pm	Breeding Balanced Bulls at Lakefield Station	Garry & Michelle Riggs
2.45pm	Breeding Balanced Bulls at Avago Station	Keith and Roxie Holzwart
3.00pm	**AFTERNOON TEA**	
3.30pm	Weighing up home bred vs. bought bulls	Trisha Cowley
3.45pm	Planning AI programs for success in the NT	Geoff Niethe
4.30pm	Selecting structurally and reproductively sound bulls	Geoff Niethe & John Bertram
5.30pm	Drinks and summary	
6.30pm	**DINNER**	

Appendix 3 – Bull Selection and Polledness Field Day Roadshow Program



FutureBeef

Bull Selection and Polledness Field Day

Monday 14th September 2015 – Montejinni Station

Program

Time:	Session:	Speaker:
9.00am	**REGISTRATION AND MORNING TEA**	
9.30am	Welcome	Carley Bidstrup
9.40am	Setting the Scene	Whitney Dollemore
10.00am	Which bull would you back?	Whitney Dollemore
11.00am	Aim, fire, recalibrate: Hitting your breeding target	John Bertram
12.30pm	**LUNCH**	
1.10pm	Data collection	Carley Bidstrup
1.30pm	Breeding the horns off your herd (Q and A)	Emily Piper
2.00pm	Selecting structurally and reproductively sound bulls (BBSE)	John Bertram
3.30pm	Drinks and summary	
4.30pm	**CONCLUSION**	

Appendix 4: Photographs from the project

2yo 2010 Bulls at Lakefield Station which Garry and Michelle Poll Gene Marker Tested

A PH 2010 bull @ 2yo

2012 Progeny from FTAI program at Lakefield Station

Attendees at the Alice Springs Field day