Appendices

Appendix I. Evaluation of the accuracy of foetal ageing by co-operating cattle veterinarians

The accuracy of the foetal ageing by cooperating veterinarians was evaluated at Pinjarra Hills University farm in December 2008, prior to the start of the project.

Twenty-three cattle veterinarians were involved in the study. Each veterinarian assessed seven cows on average. In pregnant females, the foetus was aged using half month increments to five months of age and whole increments greater than five months.

The actual foetal age at the time of pregnancy diagnoses and foetal ageing was determined using the actual date of calving.

Due to the incomplete design of this study and the resulting dataset failing tests of normality and heteroskedicity, a descriptive summary of the predicted versus actual foetal age and foetal ageing error are shown below in **Figure A**.

Overall foetal ageing via rectal palpation was thought to be accurate within 0.5 a month if conducted at less than 5 months and within 1 month if conducted greater than 5 months. Typically veterinarians overestimated the foetal age of foetuses less than 5 months, while underestimating the foetal age of foetus between 7-9 months of age.

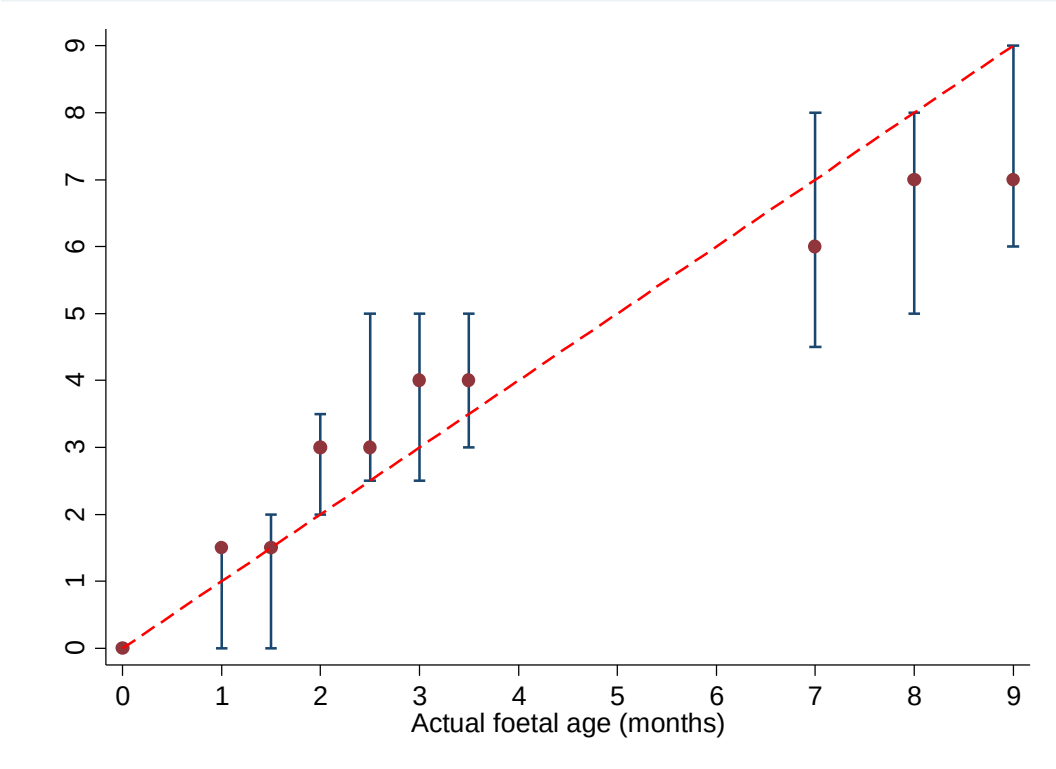

Figure A: The median (red marker) and 5th and 95th percentile bands for predicted foetal ages plotted against actual foetal age.

Appendix II. Roles of each member of the CashCow project team

Project Leader: Professor Michael McGowan (School of Veterinary Science, The University of Queensland)

Project Manager: Kieren McCosker (Northern Territory Department of Regional Development, Kieren was also the PhD student appointed to the project. The title of his thesis is 'Risk factors affecting the reproductive performance of beef breeding herds in northern Australia'. Supervisors are Mike McGowan, Peter O'Rourke and Geoff Fordyce.

Study leader—cost benefit framework: Geoff Fordyce (Department of Primary Industries and Fisheries, Charters Towers)

Regional Coordinators:

- Sandi Jephcott and Tom Newsome: South and some of West Queensland
- Geoff Fordyce and Dave Smith: Northern and Western Queensland
- Brian Burns and Dave Smith: Central Queensland
- Kieren McCosker: Northern Territory and Western Australia

Epidemiologists: Drs John Morton (School of Veterinary Science, The University of Queensland), Nigel Perkins (AusVet Animal Health Services, Toowomba) and adjunct Professor Peter O'Rourke (School of Veterinary Science, The University of Queensland)

Consulting pathologist: Dr Bruce Hill (Department of Primary Industries and Fisheries, Brisbane)

Co-ordination of collection of all rangeland management and environment data : David Smith (Department of Primary Industries and Fisheries, Charters Towers)

Co-ordination of collection of all property data including faecal samples for NIRS testing: Di Joyner (School of Veterinary Science, The University of Queensland)

Management of faecal and infectious disease sample receival and laboratory submission: Nancy Phillips (School of Veterinary Science, The University of Queensland)

MLA Project Liaison: Rodd Dyer, Mick Quirk, Geoff Niethe, and Wayne Hall

Co-ordination and conduct of electronic data capture: Tom Newsome (Outcross Pty Ltd Armidale) and Don Menzies (Outcross Pty Ltd Rockhamton)

Appendix III. **Evaluation of the accuracy of assessment of body condition score by the Outcross data collectors**

To assist in standardisation of body condition scoring across the project, a set of high quality photographs of tropically adapted cattle standing side-on and in BCS 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5 and 5 was compiled. Candidate photographs were assessed by a panel of experienced cattle researchers (**Figures B, C, D, E, F**, **G, H, I, J, K**). The agreed set of labelled photographs was provided to all data collectors early in the project. In September-October 2010, a set of six unlabelled photographs of cows in BCS 2 to 4 was emailed to each data collector. They were asked to examine each photograph and record the BCS. They were asked to take no more time than they would normally take to score cattle crush-side. The photographs were then sent to Geoff Fordyce to score - this was the 'gold standard score'. In all but two cases the data collectors' scores were within 0.5 units of the 'gold standard score. The average recorded BCS for each data collector was identical to the average 'gold standard score'.

Figure B: Body Condition 1; Very Poor

Figure C: Body Condition Score 1.5; Poor

Figure D: Body condition score 2.0; Backward

Figure E: Body condition score 2.0; Backward

Figure F: Body condition score 2.5; Average

Figure G: Body condition score 3.0; Moderate

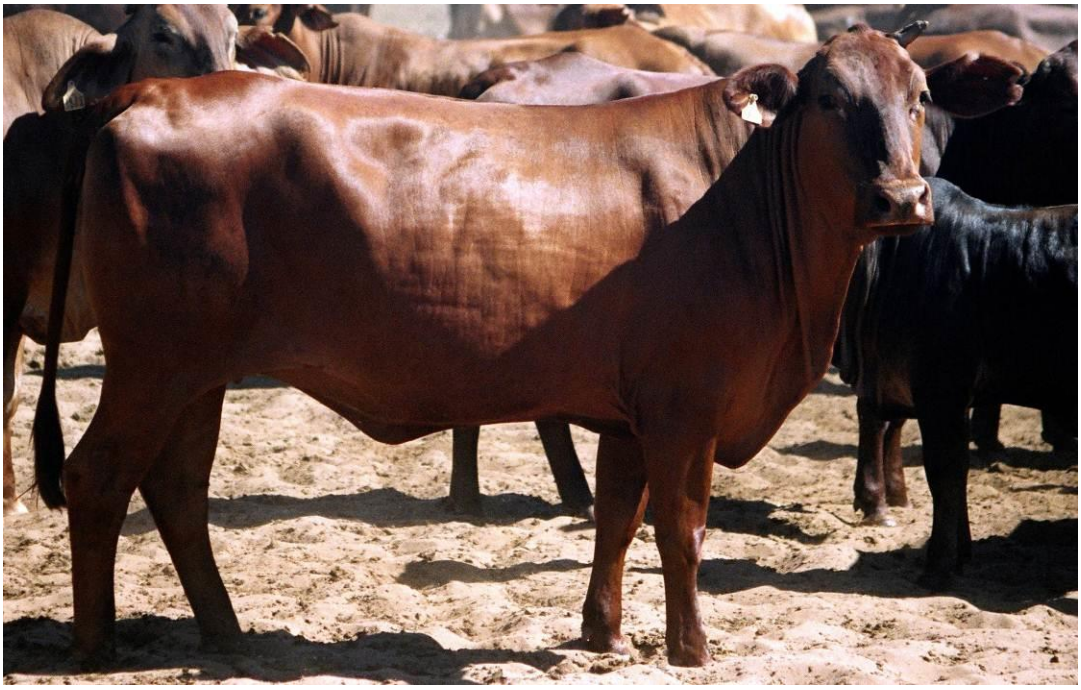

Figure H: Body condition score 3.5; Good

Figure I: Body condition score 4.0; Forward

Figure J: Body condition score 4.5; Fat

Figure K: Body condition score 5.0; Very Fat

Appendix IV. **Example of CashCow newsletter**

Cash Cow's first project meeting for co-operating producers and vets – the Longreach muster – 30th November, 2009.

Fifty-five producers, veterinarians, Outcross data collectors and members of the Cash Cow project team from across Queensland and the Barkly gathered at Longreach Agricultural College for this 2 day workshop. The primary objective of the workshop was to provide an opportunity for all those involved in this very large project to discuss how and why all the data is being collected, what we have found so far, and what improvements can be made. It was also a great opportunity for the co-operating producers and vets to meet each other and the Outcross and Cash Cow project teams and start building Cash Cow's communication net work – everyone enjoyed the dinner at the Stockman Hall of Fame's RM Williams cottage. The workshop consisted of a series of presentations, break-out discussions and practical interactive demonstrations. Summaries of the main presentations will be presented in this newsletter. John Atherton from Redcliffe Station spoke on the critical importance of collecting all the data the project requires and ensuring it is done according to the protocols laid out in the Cash Cow manual. John Lyons from Sandalwood Downs was presented with the inaugural 'bronze dung' award for submission of the most complete set of NIRS samples. The project team received very useful feedback which has already led to significant improvements in the NIRS submission sheet.

Figure 1: Photo of everyone at the Longreach Workshop.

mla MEAT & LIVESTOCK AUSTRALIA
Northern Territory Government
The University Of Queensland AUSTRALIA
Queensland Government
OUTCROSS The future direction in livestock management
AusVet Animal Health Services
Chinchilla Beef

Figure 2: "Trigger Fingers" - The Outcross Team (Meridy Kadel, Cindy McCartney, Don Menzies, Trish Cowley, Cassie Duggan, Whitney Dollemore, Tom Newsome, Laura Knight and Pru Becker)

Breeder data capture – what we have collected and what we can do to improve crush side electronic data capture?

With collaborators spread from Stanthorpe to Broome, from the Channels to the Peninsular, it has been a challenging first year of data collection for the Cash Cow project. In 2009 the Outcross team certainly racked up the kilometres as our 14 contractors travelled to all points across the north to collect the required breeder data twice a year from the 81 properties enrolled in the Cash Cow project.

More than 65,000 head were enrolled in the project in Year One – an ambitious undertaking made possible only by the vast advances in data collection technology over the past 15 years. We now have access to military spec laptops, high speed panel readers, advances in scale indicators merging with computers, huge centralised databases and customised reporting.

At Longreach, we discussed what we could do to improve crush-side electronic data capture. The main problems identified were power supply and interfacing to equipment, which will be managed with better back up systems and training on the use of equipment in Years 2 & 3 of the project.

The Outcross surveys, completed by participants at the Longreach meeting, provided valuable feedback on all aspects of the data collection process. Main points to emerge from the survey included producers and managers would like to be able to benchmark the reproductive performance of their breeding mobs, and the need for better back up and training on computer gear for the data collectors. It was commented that the process is becoming smoother as both collaborators and contractors become more familiar with the project requirements.

Please feel free to provide feedback to the principals of the Outcross team (Don Menzies or Tom Newsome) at any stage so we can continue to identify ways to improve our data collection processes, to enhance the services provided to the Cash Cow project.

Developing a common language to define the reproductive performance of breeding herds

Language for beef reproduction

Breeding animals are used to reproduce the species, ie, rear a calf to weaning/independence

Useful language

- accurately portrays an image from one person to another
- is indicative of animal and or business efficiency or is a diagnostic measure
- therefore, must be based on defined terms/language

Figure 3: Geoff being Interviewed by ABC
Read the article:
http://www.abc.net.au/rural/qld/content/2009/12/s2759974.htm
Listen to the interview:
http://mpegmedia.abc.net.au/rural/qld/countryhour/audio_m1820025.mp3

Reproduction

- The output from reproduction is sold/valued into separate components within the business, eg, heifer or steer growing, sales, etc.
- Net beef production (kilograms beef or value of beef) is the primary measures of breeder output
- Potential output (net beef production) is related to soil fertility, weather and management of pastures and animals.
- The cost of reproduction is directly related to breeder management costs which are specific to the region

Measuring reproductive performance in a beef herd ain't easy

Reproduction is at least an 18-month event for a breeding group of beef cattle and has two phases:

- Main conception phase
- Pregnancy/lactation phase

Breeders maybe in both phases simultaneously, contributing to production of 2 different calf year groups.

Between phases, cattle are often regrouped or culled, and following from one to the next requires individual ID and detailed records. We need data from at least 2 consecutive reproductive cycles to get a fair measure of mob reproductive performance. The table below lists the measures of reproductive performance we plan to use in the Cash Cow project. We are keen to get feedback from producers and vets on whether these measures are readily understood and useful.

Reproduction measures	*Calculation*				*Comment*
Annual weaning rate	=	Calves weaned	/	Breeding females	No weight or value info Often inverse of calf loss Rolling average on a herd basis useful?
Annual kg of weaner turned-off per breeder	=	Weaner weight	/	Breeding females	Predictor of biological efficiency?
Annual breeding female culling rate	=	Culled females	/	Breeding females	Indicator of cow survival?
Annual kg of cull breeding female turned-off per breeder	=	Culled female's weight	/	Breeding females	Less replacement cow wt would show cow net growth
Annual pregnancy rate	=	Pregnant females	/	Females preg tested	Important indicator of future calves
Breeder conception efficiency	=	3-month mating pregnancies	/	Females preg tested	Indicates value of future calves
Lactating breeder conception efficiency	=	3-month mating wet-cow pregnancies	/	Wet breeding females	Indicates ability to calve annually
Calf survival between confirmed pregnancy and weaning	=	Wet breeding females 1st + 2nd	/	Pregnant females	Primary indicator of neo-natal calf mortality

Reproductive performance of the CashCow Pilot mobs

The preliminary findings of analysis of the reproductive performance of the CashCow pilot mobs is summarised in Table 1. The Tropic of Capricorn was used to divide Queensland into northern and southern regions. We used the Australian Cattle Veterinarians definition of fertility (at least 90% pregnant within 2 months of commencement of mating) as our benchmark of performance of the pilot heifer mobs. Two of the 19 pilot mobs achieved this level of reproductive performance – one mob was from the NT and one from southern Qld. Note the wide variation in performance.

Table 2. Performance of CashCow pilot heifer mobs 2008 and 2009

Year	Measure		Southern Qld	Northern Qld	NT	Overall
2008	Overall percent pregnant after joining	# of Mobs	12	3	4	19
		Average	81.9	78.7	75.9	77.7
		Min	62	65.4	63.3	62
		Max	100	96.3	96.9	100
2008	Percent heifers pregnant within 2 months of start of joining	# of Mobs	12	3	4	19
		Average	74	71	62	72
		Min	50	55	42	42
		Max	97	87	92	97
2009	Percent of 2008 pregnant heifers, presenting dry at the wet/dry muster 2009	# of Mobs	12	3	3	17
		Average	7.6	9.3	21.9	10.3
		min	0	3	20	0
		max	20	16	26	26
2009	Percent of heifers recorded as wet, and diagnosed pregnant in 2009[A]	# of Mobs	9	3	1	13
		Average	77.6	41.7	91.2	70.3
		Min	42	9	91	9
		Max	92	95	91	95

[A]: This does include females that were culled at first round, with known pregnancy status.

Across all regions approximately 10% of heifers palpated as being pregnant in 2008, presented dry at the wet/dry muster in 2009. Again note the wide variation in recorded losses from pregnancy diagnosis to weaning 0-26%. Also on average, 85% of the dry heifers had reconceived by the time of pregnancy testing in 2009. The rate of reconception in the wet pilot heifers was generally high, around 70%. However, the proportion that would have been detected as pregnant at first round, and subsequently will wean a calf by first round 2010 is yet to be calculated. A more complete analysis of the pilot heifers will be soon completed and is intended to be the basis of the next newsletter.

Figure 4 & 5: Worshops and lunch discussion

How much more valuable is an early early born calf versus late born calf?

This was the title of one of our break-out sessions and generated a lot of great discussion and debate. Workshop attendees were given 2 scenarios to consider; a herd using controlled mating for 4months and a continuously mated herd; also the reproductive performance of each herd was defined using the new Cash Cow measures of reproductive performance. The key points from the discussion are highlighted below:

- There was a quite a lot of debate about the definition of early and late born calves. One definition which is frequently used is early calves are those born between July and November and late calves are those born after December.
- There was general agreement that the value of a weaner was influenced strongly by the target market, and variable seasonal conditions could impact significantly on the value of calves born and subsequently weaned at different times of the year e.g if the break in the season is late calves born before this time may be setback and their mothers will lose a lot of body condition and take longer to reconceive.
- When considering the value of calves born at different times of the year you need to take into account likely impact of time of birth on the females future fertility and survivability.
- Producers using controlled mating felt that there was only small variation in the value of calves born over the first few months of the calving season but calves born after this were generally less valuable except if they could access southern weaner markets.
- When considering replacement heifers early born calves were valued more than later born calves

To provide some estimates of the difference in value of early versus late born calves, Trisha Cowley, Pastoral Production Officer from the NT's Katherine Research Station will be working with Geoff Fordyce and Bill Holmes over the next 6 months on a research project modeling the economics of different patterns of herd weaning e.g 2/3 of calves weighing> 150 kg weaned at 1st round versus 2/3 of calves weighing 100-150kg weaned at 2nd round.

Figures 6-8: Worshop in the cattle yards

"The effect of reproductive performance on profitability in breeder herds." (excerpts from presentation by Geoff Niethe)

The profitability of breeder herds can be optimised by altering the average age of the breeder females in the herd and tightening the calving pattern. These principles are further investigated using examples below.

Maximising profits in the breeder herd

Because every herd is different and the input costs and prices received will vary enormously, the discussion that follows will not even attempt to encapsulate these variations but will provide some key concepts to consider in understanding the importance of reproductive performance and profitability. The following prices received for cattle have been used in Bill Holmes Breed cowplus economic model. The herds have been set up to sell 18 month old steers at $640 a head and cull about 10% breeding from all age groups.

Age at sale	Wnrs.	1	2	3	4	5	6	7	8	9	10	11
Heifers/cows	$300	$555	$650	$750	$750	$750	$750	$750	$750	$750	$750	$350
Spayed females ..	na	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Steers/bullocks ..	$350	$640	$0	$0	$0	$0	$0	'or bullocks past 6 yrs of age				

Herd ----------→	A	B	C	D
Total adult equivalents	369	369	369	369
Total cattle carried	442	443	441	436
Weaner heifers retained	80	87	94	98
Total breeders mated	295	272	258	240
Total breeders mated & kept	274	260	246	233
Total calves weaned	160	175	187	197
Wnrs/cows mated and kept	59%	67%	76%	84%
Overall breeder deaths	0.77%	0.77%	0.80%	0.86%
Total cows and heifers sold	78	86	92	96
One yr old heifer sales % .	23.00%	33.00%	47.00%	67.00%
Two yr old heifer sales % ...	10.00%	10.00%	10.00%	0.00%
Total steers & bullocks sold	79	87	93	97
Max bullock turnoff age	1	1	1	1
Average female price	$695.30	$676.28	$632.27	$559.89
Average steer/bullock price	$640.00	$640.00	$640.00	$640.00
Net cattle sales	$105,027	$113,287	$117,160	$116,191
GM/AE after interest	$211.17	$235.50	$247.02	$245.74

The important factors to note from the table above is as follows:-

- The overall carrying capacity of the property has remained constant at 369 AE's
- The number of calves weaned increased as weaning rates increased.
- The numbers of heifers available for sale (cull heifers) increased greatly as weaning percentages increased.
- As weaning/cows mated and kept increased, the gross margin /AE increased up to 76% (Herd C) but then dropped slightly as weaning rates reached the highest possible value of 84%.
- The average female sale price (includes females from all cohorts – cull heifers, cull cows, CFA cows) declined as weaning percentage increased.
- The return from female sales can almost be as high as the return from male sales as the age of turnoff of the male cattle decreases.

(It was assumed that cows could be sold as fat cows (empty), cows with calf at foot or PTIC cows at $750 each.)

Now the outputs achieved in Bcowplus will vary enormously as the price differentials between the various cohorts of stock changes. No attempt was even made to try and put a dollar figure on the cost required to improve conception rates. The message is really not so much that higher weaning percentages will not necessarily mean better returns BUT that there may be opportunities to maximize profitability by carefully exploring all options of selling females.

Value Adding Female Sales
There are various opportunities between weaning and 'cull for age' to market females. The prices on offer need to be examined closely to ensure that the best mix of options is achieved. The general principle being try to minimize the percentage of old cracker cows that at the end of the cycle.

A key question is "What is the minimum conception rate I need to achieve to ensure that I produce enough saleable animals every year?" This was subsequently examined on a breeder herd that used yearling mating, culled 30% heifers each year and had a handful of aged cows to calve each year. The absolute minimum pregnancy rate required is in the vicinity of 70-75%.

Condensed Calving pattern:
The second way to improve increased profitability is to tighten up the calving period. There are two ways this can be achieved – controlled joining and or with foetal aging at pregnancy testing. Its not essential that bulls are removed from the herd as the same effect can be achieved by foetal aging and culling those females that are early pregnant or empty. The additional benefits of a condensed calving period are reflected in the altered weights and value of the sale cattle.

	Number	Wt	$/Kg	Av Price
No 5 Steers (Early Season 04/05)	**54**	**435Kg**	**$1.85**	**$806**
No 5 Steers (Late Season 2004/05)	**46**	**356Kg**	**$1.65**	**$588**
Difference in Value/Head (Early & Late Steer) ----------		**79Kg**	-------→	**$218**

Better reproductive management ie a tighter calving distribution had the potential to increase net returns by $10,028/100 steers turned off. The impact on heifer fertility and decreased management costs were not examined in this example.

In summary (Take home message):

- Make sure you know exactly how you are calculating your reproductive performance.
- Aim for conception rates as high as possible and certainly >70%.
- Examine your cull heifer/cull cow policy and maximise the average cull female price – avoid selling crackers where ever possible.
- Overmate replacement heifers so you have increased options depending on markets.
- Aim to condense calving where ever possible.
- Don't keep unproductive females in the herd.
- Minimise breeder cow mortality rates as a priority.
- Seek assistance or do a Bcowplus course explore all options of herd modeling.

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Preliminary analysis of NIRS results for Year 1 of the Cash Cow project

Dietary Crude Protein

Observations

- Only in Southern Qld , the Barkly and Western Qld did CP levels stay above the maintenance threshold from the early dry onwards
- WQ had good wet season figures, but CP rapidly dropped in the dry season
- Barkly appears to have had a later start to the wet, and CP levels held fairly well through the dry
- SQ appears to have had a slight increase in CP during the early dry

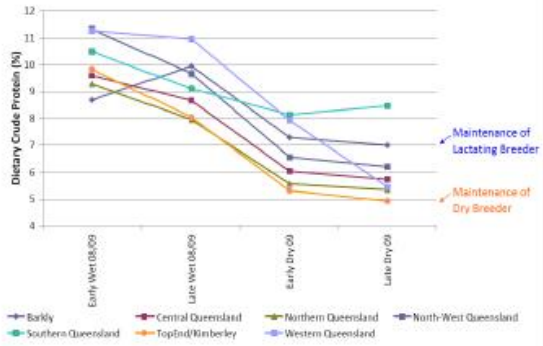


Figure 9: Dietary Crude Protein (CP) content of the pasture grouped by region to Aug 09
Early Wet (Nov-Jan), Late Wet (Jan-May), Early Dry (May-Aug), Lat Dry (Aug-Nov)

Dry Matter Digestibility (DMD) - *an indication of energy levels in the pasture diet.*
If we use 55% as our lower limit for maintaining a lactating cow, we can see a number of regions were limited by energy availability from the early dry onwards. This is normal for some regions, but a reflection of a harsher than normal dry season for others.

Figure 12:
Photo from Lindsay & Avriel Tyson's back gate
"That is Sandy Creek out of its banks. Very very wet here - no dung samples for Nov and Jan - too many fires and then too wet. We have fish swimming around under the clothes line in our back yard and in the lawn and we live on a hill. The fish swim up the road. We have had incredible rain - 900+ ml since Christmas - very big floods in all our creeks and we are completely isolated. Cannot see how our cows are."

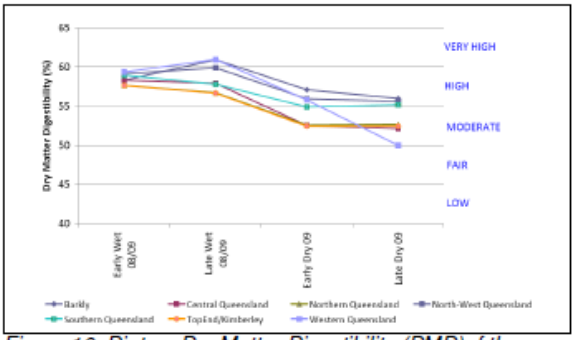


Figure 10: Dietary Dry Matter Digestibility (DMD)of the pasture grouped by region to Aug 09
Early Wet (Nov-Jan), Late Wet (Jan-May), Early Dry (May-Aug), Lat Dry (Aug-Nov)

Observations

- WQ had good wet season figures, but DMD rapidly dropped in the dry season
- Top End and NQ tracked closely together as might be expected
- CQ DMD dropped quicker in the early dry than might be expected
- Top End, NQ, CQ & SQ digestibility (energy) levels had dropped to maintenance or below by early dry, and WQ follow suit by the late dry

Phosphorus results

The faecal Phosphorus testing is done in batches (runs), hence the longer time frame for results to become available. These are coming through now and your property results will be sent out soon. A preliminary regional summary is provided below.

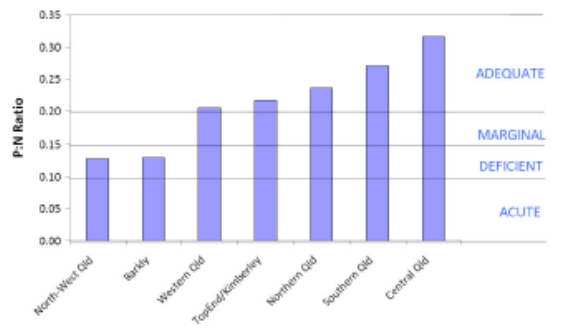


Figure 11: P:N ratio - grouped results to Aug 09

These summary graphs are a 'first cut' - it is recognised that there will be variation within regions. Top End and NQ shows adequate P status – this may be a reflection of P supplements being fed

Collection of Branding and Weaner Data

During the afternoon of the final day workshop sessions were held on the collection of the data required by the project. One of the sessions was on collection of weaner data. Weaner information is of critical importance as it the primary measure of the beef output of the mobs we are monitoring.

There are three templates that provide us with the required branding and weaning data. These include:
14.4 – Branding Report (to be completed each time calves are branded)
14.5 – Weaning Report (to be completed each time calves are weaned)
14.6 – Weight recording sheet (this is only to be used in the cases where weights cannot be recorded electronically)
If you require any copies of these templates please let Di or Kieren know.

Issues raised and explained.

Assistance with collecting weaner data

In a number of cases, collection of breeder data will be scheduled to occur around the time of weaning. In mobs where this is the case, the Outcross data collectors can assist in collecting the weaning data. Please contact Don Menzies or your regional co-ordinator to organise this.

Selection of Weaners

In mobs where less than 150 calves are being weaned the required data should be collected from all weaners. In mobs where more than 150 calves are being weaned data collection of data from a representative sample of weaners is acceptable. Wherever possible, collection of data from all weaner calves is preferred.

If the representative sample approach is being used it is very important is that the sample is a genuine cross section of the weaners taken off of the mob. To be sure of this two methods are recommended:

1. Divide the total number of calves weaned by 150 and then collect the required data from every N^{th} calf e.g if you estimate that there were 450 calves in the mob then you will weigh etc every 3^{rd} calf that comes through the race
2. For very large mobs of weaners (>500 head) collect the required data from lots of 30 weaners at a time i.e you will weigh etc the first 30 weaners which come through the race, then let 60 weaners run through, then weigh etc the next 30 calves and so on.

Weighing protocol

Weight can be affected by a number of factors. For us to account for these factors and make the required corrections to the data we need to know the number of days between when the calves were removed from the breeders and when they were weighed and whether feed and or water curfews of 12 hours or more have been applied (the code letter). Please use the curfew code outlined below:

- P: No curfews applied
- W: On water and off feed
- D: Off feed and water
- F: On feed and off water
- X: Variable or unknown

Examples of how to report the weighing protocol on the weaner template sheet are provided below:

- 0X: Mustered and weighed on the same day. A proportion of the group had access to water on that day prior to weighing.
- 1D: Mustered and held in yards overnight off feed and water before weighing.

Date of Separation and Processing: With weaner weighing in the CashCow project it is essential that 'Day of separation' and 'Day of processing' are recorded. This will indicate how long the weaners have been held in yards and small holding paddocks before processing. It is also important to record cleanskin weaners, i.e. those that are branded, tagged, dehorned etc., as their stress levels may be higher and, therefore, weight loss increased. Finally, if weaners are weighed after shipping to a second property, this should also be recorded.

Figure 13.: Sturt Plateau, NT

CASHCOW CONTACTS:

Michael McGowan – Project Leader
Mobile: 0434 076 180
Email: m.mcgowan@uq.edu.au

Di Joyner - Sample and Data Collection Coordinator
Mobile: 0433 268 273:
Email: cashcow@uq.edu.au

Sandi Jephcott - Southern Queensland
Phone: 0746627637
Email: chinchillavet@westnet.com.au

Brian Burns - Central and Western Qld
Phone: 074936 0338
Mobile: 0419641102
Email: brian.burns@deedi.qld.gov.au

Dave Smith - North & North-West Qld
Phone: 07 4761 5160
Mobile: 0409 580357
Email dave.smith@deedi.qld.gov.au

Geoffry Fordyce - North & North-West Qld
Phone 07 4761 5173
Mobile 04 2810 9062
Email: geoffry.fordyce@deedi.qld.gov.au

Kieren McCosker - NT/WA and Project Manager
Phone: 08 8973-9771
Mobile: 0447 828-315
Email: kieren.mccosker@nt.gov.au

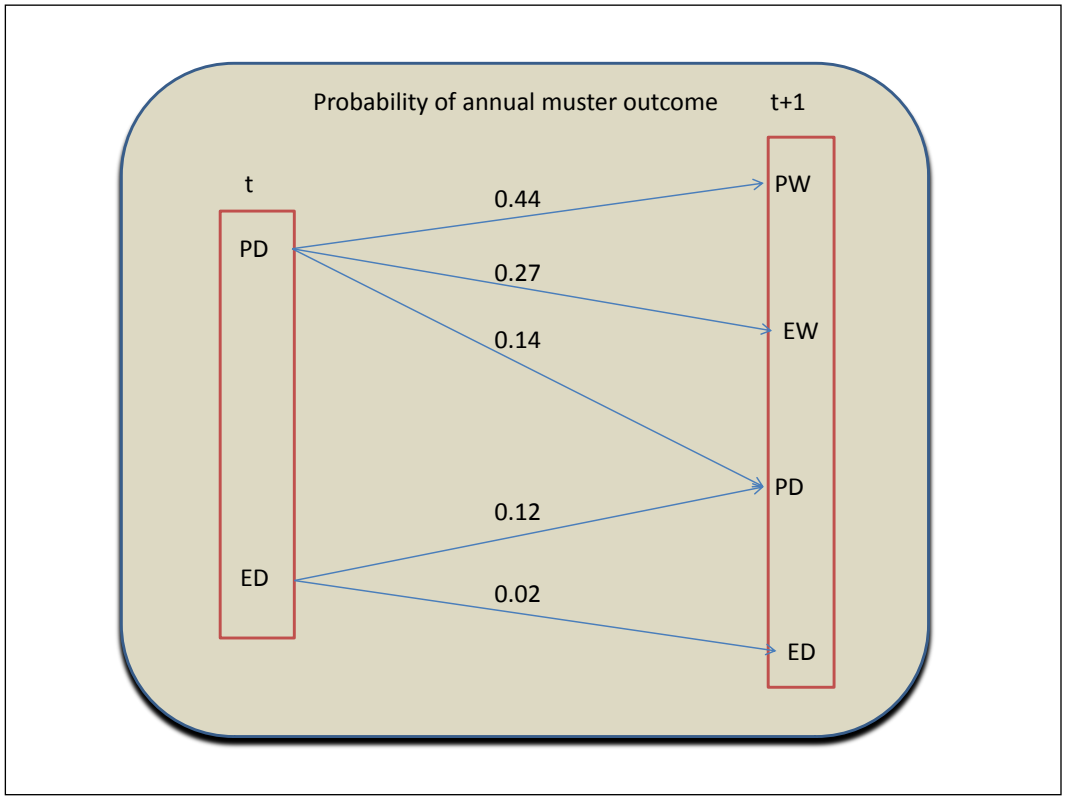
Outcross Performance: Tom Newsome
Mobile: 0409 580 732
Phone: 02 6732 2298
Email: tom@outcross.com.au

Don Menzies
Phone: 07 4927 4160
Mobile: 0410 319 027
Email: don@outcross.com.au

"The Longreach Workshop Honeymooners on the Big Day"

Appendix V. Analysis of selected Beef CRC III and commercial property data used to inform design of CashCow analyses and measures of reproductive performance

This analysis was conducted by Ricardo Soares (PhD candidate, The University of Queensland). In the Beef CRC dataset provided to the CashCow project a total of 1796 females were available for determination of the likelihood of different reproductive pathways. This dataset contained the outcomes for two mating periods: 2003 and 2004. The females in each mob were examined by transrectal ultrasonography monthly or bimonthly throughout the year and lactation status was defined at a mid-point between mating start date and end of mating. The mating period typically started from late November to late January and ended in late February to mid-April. Therefore, the pregnancy test results analysed used the mid-point during this period. Analysis of the data indicated that the predominant reproductive pathway was pregnant and not-lactating at the initial 'annual' pregnancy test muster (2003) to pregnant and lactating (44%) at the following muster 12 months later (2004) (**Figure L**). In addition, those females which were observed not-pregnant and not-lactating in the initial pregnancy test muster predominantly transited to pregnant and not lactating in the subsequent annual muster (12% of all available transitions). Note the Beef CRC herds were very well managed and cattle where cattle were observed to be losing condition intervention strategies were implemented. As a consequence mortality rate in these herds was very low.



Key: E – not pregnant; P – Pregnant; W – Lactating; D – not-lactating.

Figure L: Probabilities of different reproductive pathways, based on records from 1796 females at two successive 'annual' muster periods.

The analyses conducted on the Beef CRC III data particularly focused on the probability of an observed pregnancy/lactation combination at two successive annual musters resulting in the actual weaning of a calf or not. This was critical for the Cash Cow project because there was no opportunity to mother-up calves on the enrolled properties and thus losses from pregnancy diagnosis to weaning could only be determined from analysis of subsequent lactation status of pregnant heifers and cows. Ninety-seven percent of all pregnant and dry to pregnant and wet transitions (the predominant pathway observed in the Beef CRC III herds) resulted in the weaning of a calf. However, 14% of reproductive pathways were from pregnant and dry to pregnant and dry. This pathway was of particular interest and further analysis showed that 50% (n=124) of females that had this reproductive

pathway experienced perinatal loss, 21% (n=52) experienced postnatal loss, 16% (n=39) aborted, 8% (n=20) lost a calf just before weaning, and 5% (n=11) reconceived and lost the calf.

Using survival analyses the efficiency with which females conceived in the Beef CRC III herds in two consecutive mating periods was assessed (**Figure M**). Clearly there were very marked differences between breeding seasons in the efficiency of re-conception in these herds, suggesting that an environmental factor such as drought was having a major effect on cows cycling and conceiving in these herds.

The probability of foetal/calf loss in 2003 and 2004 was also determined using survival-time analysis (**Figure N**). The results suggest that from pregnancy diagnosis to weaning the majority of losses occur within approximately a month of calving. Interestingly, the mating period effect on re-conception (**Figure M**) does not seem to have had a knock-on effect on the proportion of losses from pregnancy diagnosis to weaning observed in different mating periods. This provides evidence that risk factors for losses from pregnancy diagnosis to weaning are not necessarily the same as those for conception efficiency.

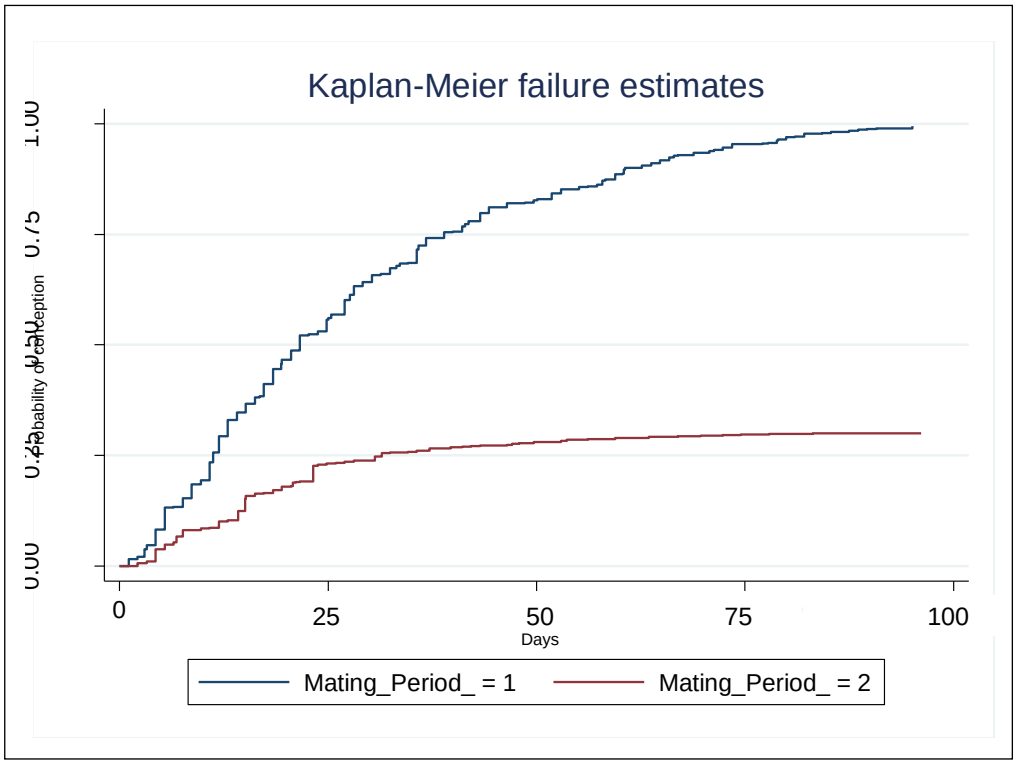


Figure M: Estimated efficiency of re-conception in Beef CRC herds in the 2003 and 2004 breeding seasons.

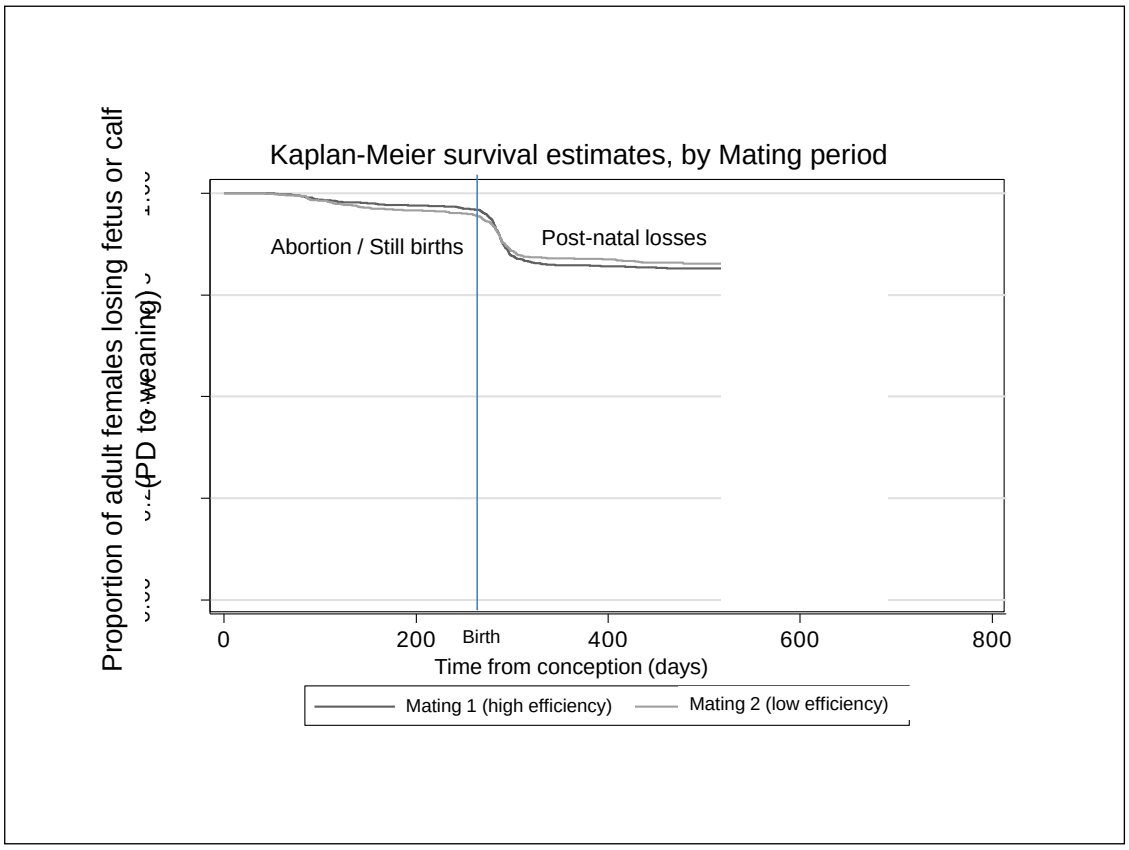


Figure N: Temporal analysis of the magnitude of losses from pregnancy diagnosis to weaning in Beef CRC herds for the 2003 and 2004 breeding seasons.

Appendix VI. **Nutrition report provided to CashCow producers**

NIRS Report for CC35M

Analysed: Fri Sep 07, 2012 @ 15:24

Breeder mob

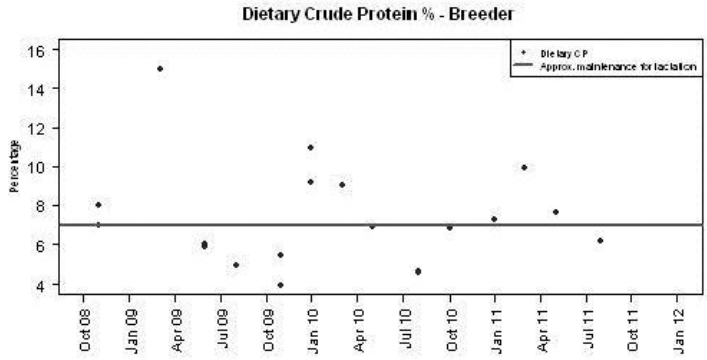
	Date	Paddock	Sample No	Dietary CP	DMD	Non-grass	Phos (g/kg DM	P:ME	Phos status	Cond. score (wet)	Cond. score (dry)	Pasture yield
1	25/11/2008	Burns	E38444	7.0	53	14	2.07	279	<500	3.2	3.9	1000-2000
2	25/11/2008	Holroyd	E38443	8.0	54	18	2.04	269	<500	3.2	3.9	1000-2000
3	27/03/2009	Holroyd	E39429	15.0	66	30	4.24	440	<500			
4	10/06/2009	Burns	E39428	5.9	54	17	1.80	237	<500			
5	10/06/2009	Holroyd	E39430	6.0	53	23	1.63	220	<500			
6	07/08/2009	Burns/Holroyd	E39597	4.9	53	16	1.65	222	<500	3.2	3.3	2000-3000
7	06/11/2009	Burns	PMC1065	5.4	51	22	2.72	385	<500	3	3	500-1000
8	06/11/2009	Holroyd	PMC1064	4.0	48	21	1.76	269	<500		3.2	500-1000
9	04/01/2010	Burns	PMC4076	9.2	55	11	2.26	293	<500	3.6	3.6	2000-3000
10	04/01/2010	Holroyd	PMC4075	10.9	60	11	2.88	334	<500	3.6	3.6	2000-3000
11	01/03/2010	Holroyd/Burns	PMC4158	9.0	58	25	2.66	322	<500	3.5	4.2	3000-4000
12	30/05/2010	Burns/Holroyd	PMC4412	6.9	53	30	1.99	267	<500	2.7	4	3000-4000
13	17/08/2010	Burns/Holroyd	PMC4484	4.6	50	12	1.85	272	<500			
14	31/10/2010	Burns/Holroyd	PMC4451	6.8	54	14	1.91	255	<500		3.7	3000-4000
15	19/01/2011	Holroyd	PMC4569	7.3	56	12	2.97	371	<500			3000-4000
16	02/03/2011	Holroyd	PMC4599	9.9	58	26	2.56	310	<500	3.2	3.8	3000-4000
17	17/05/2011	Holroyd	PMC4696	7.6	51	43	1.58	223	<500	3	4	2000-3000
18	04/08/2011	Holroyd	PMC4773	6.2	49	43	1.84	273	<500	3.1	4.7	3000-4000

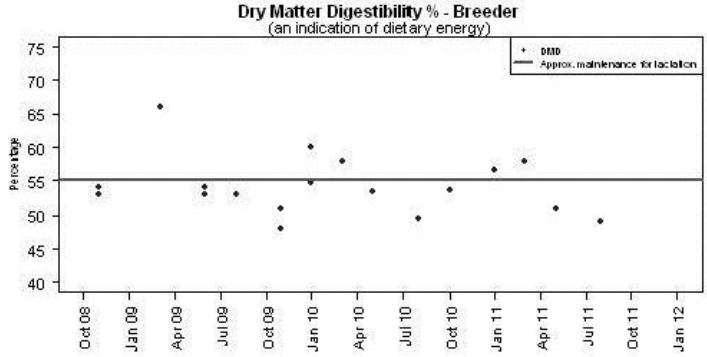
Heifer mob

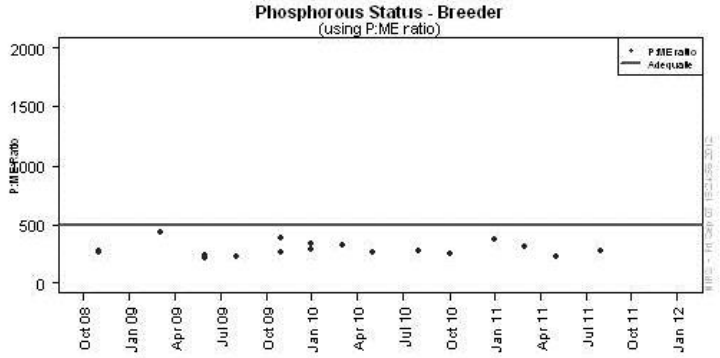
	Date	Paddock	Sample No	Dietary CP	DMD	Non-grass	Phos (g/kg DM	P:ME	Phos status	Cond. score (wet)	Cond. score (dry)	Pasture yield
1	25/11/2008	Durand	E38445	6.7	52	8	1.66	229	<500		3.5	1000-2000
2	27/03/2009	Bluewater/Durand	E39426	11.6	64	31	2.81	302	<500			
3	01/06/2009	Bluewater/Durand	E39427	5.5	52	15	1.59	220	<500			
4	07/08/2009	Bluewater/Durand	E39596	4.5	51	9	1.48	209	<500		4	2000-3000
5	06/11/2009	Bluewater/Durand	PMC1066	4.5	51	17	2.29	324	<500	2	2.9	500-1000
6	04/01/2010	Bluewater/Durand	PMC4074	10.2	59	13	2.66	318	<500	2.8	3.5	2000-3000
7	01/03/2010	Bluewater	PMC4157	8.4	59	7	2.98	352	<500	3.2	4.3	3000-4000
8	30/05/2010	Bluewater	PMC4411	10.9	56	63	2.03	255	<500	3.5	4	3000-4000
9	17/08/2010	Bluewater	PMC4483	7.0	51	50	1.59	223	<500			
10	31/10/2010	Winks	PMC4450	8.6	58	14	2.34	284	<500		3.8	2000-3000
11	19/01/2011	Winks	PMC4568	8.6	58	20	2.81	343	<500			2000-3000
12	02/03/2011	I & J Winks	PMC4598	9.2	57	26	2.59	320	<500			2000-3000
13	17/05/2011	Winks	PMC4695	9.7	55	60	1.85	239	<500	3.2	4.4	3000-4000
14	04/08/2011	Winks	PMC4772	5.4	48	28	2.36	361	<500	3.3	4.7	2000-3000

Breeder mob

Nutrition

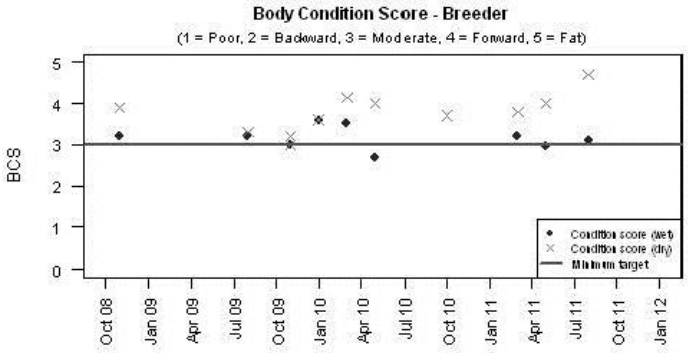


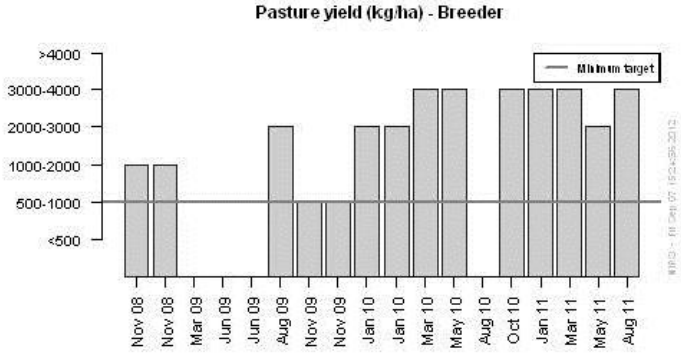




Breeder mob

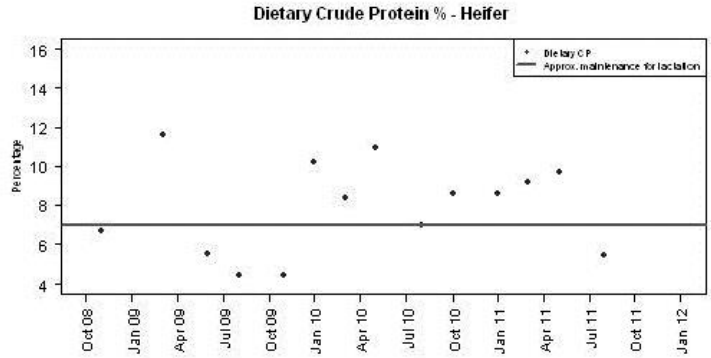
Body Condition score and Pasture yield

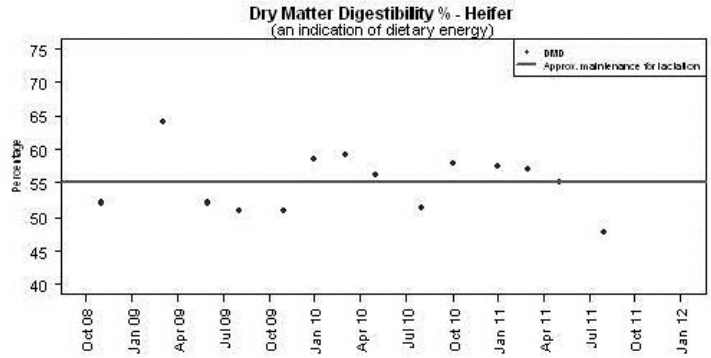


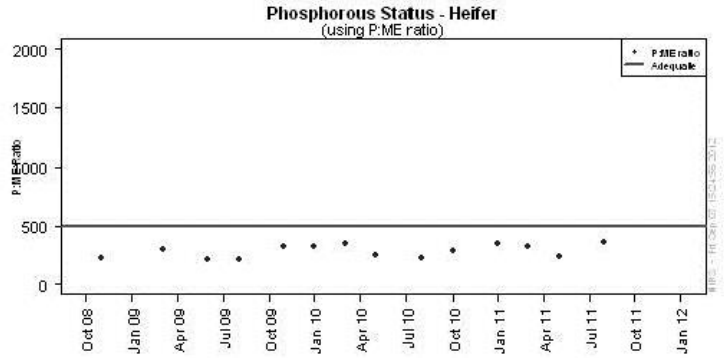


Heifer mob

Nutrition

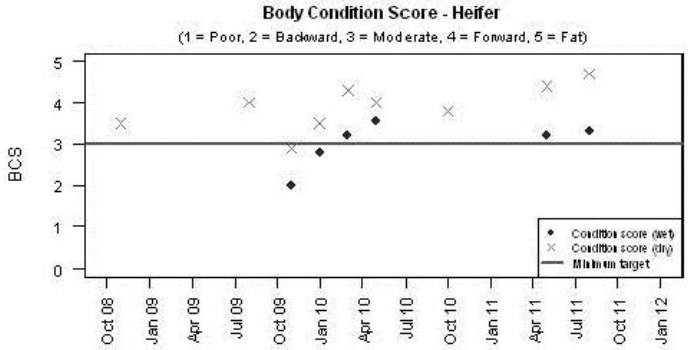


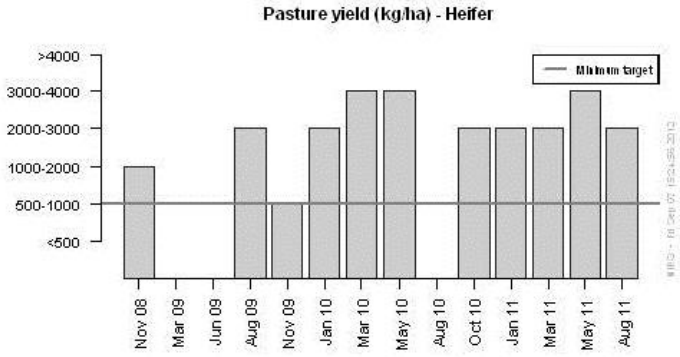




Heifer mob

Body Condition score and Pasture yield





Appendix VII. Example of NIRS data collection sheet accompanying NIRs samples

Print out and post this completed sheet with the faecal sample to Nancy Phillips

1. Client Details	
Property Code	**CC**
Mob	☐ Heifers ☐ Breeders

2. Sampling		
Date collected *dd/mm/yy*		☐ Sun Dried ☐ Oven Dried *Tick one box*

3. Paddock Details	
Paddock Name	
Pasture Type/s	

4. Estimated Pasture Yield						
Tick one box	<500 kg/ha	500-1000 kg/ha	1000-2000 kg/ha	2000-3000 kg/ha	3000-4000 kg/ha	>4000 kg/ha
	☐	☐	☐	☐	☐	☐

5. Fire			
Fire since the last sample? Yes ☐ No ☐	Date	% burnt	Intensity
			Cool ☐ Med ☐ Hot ☐ *Tick one box*

6. Description of Mob ***(Describe lactating and dry individually)***						
Condition score	**Poor 1**	**Backward 2**	**Average 3**	**Good 4**	**Fat 5**	
%age of Lactating cows (in each condition score)						**=100%**
%age of Dry cows (in each condition score)						**=100%**

7. Cattle weight performance *(Tick one box)*
Gaining ☐ Holding ☐ Losing ☐

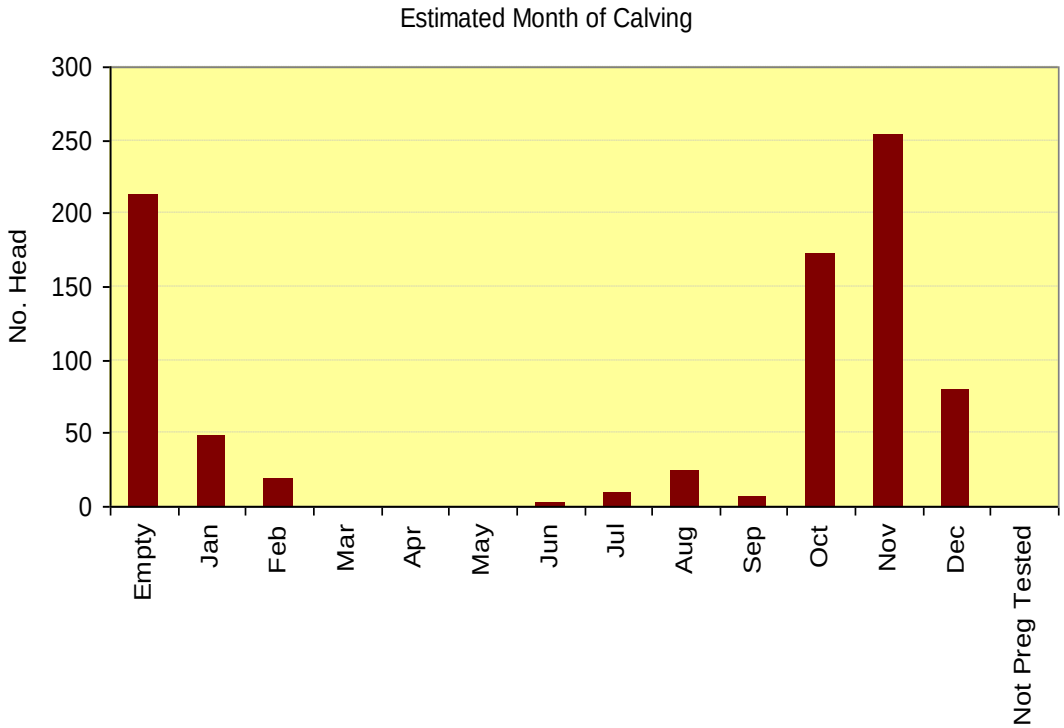
8. Description of supplement (at time of sampling)		
Supplement Type *Tick a box*	**General description of supplement** *ie 30% urea Stocklick dry season mix*	**Intake** *grams or litres / hd / day*
Nil ☐		
Dry Lick ☐		
Molasses based ☐		
Grain based ☐		
Other ☐		

9. Any additional comments

Appendix VIII. **Examples of Pregnancy Test Report, Wet & Dry Report and Weaning Report sent to cooperating producers**

	No. of Head	**PTIC %**	**PTE %**
TOTALS	**824**	**74.27%**	**25.73%**

CONDITION SCORE		PTIC %	PTE %				
1.5	1	0%	100%	300	1.5		
2.5	47	68%	32%	301	2.5	20-Oct-08	
3	768	75%	25%	346	3.0	2-Nov-08	
3.5	7	86%	14%	378	3.5	17-Nov-08	
5	1	100%	0%	274	5.0	31-Oct-08	



Appendix IX. **Details of animal-, analysis mob- and property-level risk factors used in statistical analyses**

Variable	*Detail*	*Comment*
Animal-level: Age (at reproductive cycle 1 and 2)	Young: ≤3yrs of age Mature: 4-7 yrs of age Old: ≥8 yrs of age	– if we are analysing the heifers separately is this necessary
Mob-level: Genotype	Not Tropically adapted: Females estimated to be less than 25% tropically adapted Tropically adapted composite: Females estimated to be 25-75% tropically adapted *Bos indicus* – 100% tropically adapted	
Animal-level: Previous Annual Lactation status	Lactated Did not Lactate	
Animal-level: Current Lactation Status	Lactating Not Lactating	
Animal-level: Pregnancy status - previous reproductive cycle	Pregnant Not pregnant	
Animal-level: Body condition score at previous PD muster	<2.5: Backward or worse 2.5: Average 3.0: Moderate 3.5: Good >3.5: Very good or better	
Animal-level: BCS at Wet/Dry muster	<2.5: Backward or worse 2.5: Average 3.0: Moderate 3.5: Good >3.5: Very good or better	
Animal-level: Change in body condition scores between PD and Wet/Dry muster	Lost ≥0.5 Maintained Gained ≥0.5	
Animal-level: Previous predicted Calving Period (including Non-pregnant)	Jan-Mar Apr-May June-Sep Oct-Dec Not pregnant	
Animal-level: Previous predicted Calving Period (including Non-pregnant)	By month or period Not pregnant Failed to rear	

Animal-level: Weaned-a-calf previous reproductive cycle.	Contributed weaner Did not contribute weaner	Weaning-a-calf predicted from foetal ageing and lactation status at subsequent musters following predicted month of calving
Animal-level: Hip Height at Induction	Let data calculate 3 bands – lower 25%, Middle 50% and Upper 25%.	Analyse after removing upper and lower 5%
Animal-level: Change in hip height (heifers)	Let data calculate 3 bands – lower 25%, Middle 50% and Upper 25%.	
Mob-level: Maiden heifers in contact with mature breeders during calving (heifers)	Yes No	
Animal-level: Live weight at Wet/Dry muster	lower 25%, Middle 50% Upper 25%.	Let data calculate 3 bands –
Animal-level: Live weight at PD muster	lower 25%, Middle 50% Upper 25%.	Let data calculate 3 bands –
Animal-level: Change in Live weight between PD and Wet/Dry musters	Lost ≥ 30kg Maintained weight Gained ≥ 30kg	
Animal-level: Average dry matter digestibility of pasture during first 3-months after calving	<55% DMD 55-65% DMD >65% DMD	
Animal-level: Average dry matter digestibility of pasture during last 3-months of gestation	<55% DMD 55-65% DMD >65% DMD	
Animal-level: Average dry matter digestibility of pasture during first 3-months after calving	<5% CP 5-7% CP >7% CP	
Animal-level: Average dietary crude protein of pasture during last 3-months of gestation	<5% CP 5-7% CP >7% CP	
Mob-level: Dry season pasture quality	Low No Supplement: August DMD <55% Low Supplement Fed: August DMD <55% and urea based supplement fed Adequate: August DMD >55%	what if we did not have an August sample but had a Sept or July sample – maybe this should be a period
Mob-level: Minimum pasture yield (May-August)	<500 kg: The minimum average amount of pasture available during May and August was estimated to be	

	less than 500kg. 500-1000 kg: The minimum average amount of pasture available during May and August was estimated to be between 500-1000 kg. >1000 kg: The minimum average amount of pasture available during May and August was estimated to be greater than 1000 kg.	
Mob-level: Pasture availability	Poor: August pasture <1000kg/ha and >30% of paddock >2.5km from water Low: August pasture <1000kg/ha and <30% of paddock >2.5km from water Adequate: August pasture >1000kg/ha	
Dry season nitrogen status	Not deficient: Response to nitrogen supplementation not likely Deficient no supplement fed: Response to nitrogen likely but no supplement fed Deficient supplement fed: Response to nitrogen likely and appropriate supplement fed Strategic supplementation: High maintenance requirement females have been identified through segregation and were strategically supplemented.	– what if they did feed N supplement
Faecal phosphorous status during first 3-months after predicted calving	Not deficient: Response to phosphorous supplementation unlikely Deficient and no supplement fed: Response to phosphorous likely but no supplement fed Deficient and supplement fed: Response to phosphorous likely and appropriate supplement provided	
Proportion of paddock within 2.5km of permanent water – last 3months of gestation; first 3months after calving	<50%: less than 50% of the paddock area within 2.5km of permanent water. 50-80%: 50-80% of the paddock area within 2.5km of permanent water. >80%: greater than 80% of the paddock area was within 2.5km of permanent water.	– with many of these risk factors we will need if possible a reference or the basis for the risk factor included in appropriate section of report
Effective stocking rate within 2.5km of permanent water – last 3months of gestation;	Low: to be defined further Moderate: to be defined	

first 3months after calving	further High: to be defined further	
Broad land type description	Southern Forest: Central Forest: Northern Downs: Northern Forest:	
Onset of wet season - date	Early: the onset was prior to the November 15. Normal: the onset was between November 15 and December 31. Late: the onset was between the January 1 and March 31. Did not occur: if the onset occurred after the March 31 it was considered not effective and therefore as not occurring.	
Onset of wet season - median	Early: >30 days before long-term median Normal: Within 30 days of long-term median Late: >30 days after long-term median	
Duration of wet season	Short: a wet season less than 4 months in duration. Normal: a wet season between 4-6 months in duration. Long: a wet season greater than 6 months in duration.	
Wet season rainfall	<90% of average wet season rainfall 90-110% of average wet season rainfall >110% of average wet season rainfall	
Occurrence of extreme climatic events within 2months of calving	No Impact: Natural disasters were not considered to have had no impact on the reproductive performance of the management group. Minor Impact: Natural disasters were considered to have had a minor impact on the reproductive performance of the management group. Major Impact: Natural disasters were considered to have had a major impact on the reproductive performance	

	of the management group.	
Estimated average Temperature Humidity Index during estimated month of calving	Nil heat stress (THI≤72) Low heat stress (THI >72 & ≤79) Medium heat stress (THI >79 & ≤89) High heat stress (THI >89 & ≤99)	THI was estimated by the equation: $0.8T + RH(T - 14.4) + 46.4$ Where: T=ambient or dry-bulb temperature in ^{o}C RH=Relative humidity expressed as a proportion
Number of days potential mild heat stress experienced during predicted month of calving		THI>72
Number of days potential severe heat stress experienced during predicted month of calving		THI>79
Number of days potential very severe heat stress experienced during predicted month of calving		THI>89
Number of days potential extreme heat stress experienced during predicted month of calving		THI>99
Number of hot days (≥33°C) during predicted month of calving	Nil Low (<5) Medium (5-10) High (>10)	
Number of very hot days (≥40°C) during predicted month of calving	Nil Low (<5) Medium (5-10) High (>10)	
Wild dog presence and control	Not present: Wild dogs have not been seen on the property Present and nil or little control: Wild dogs have been seen on the property and are not actively controlled. Control measures such as shooting maybe conducted. Present and actively controlled: Wild dogs have been seen on the property and recognised methods (baiting and trapping) for their control are routinely used.	Present or Not determined by question – do you consider dogs contributing to reproductive loss.
Mob size (use frequency distribution)	≤100 cattle: Female breeding cattle are managed in mobs of less than or equal to 100 cattle. 100-500 cattle: Female breeding cattle are managed in mobs of between 100 to	

	500 cattle in size. >500 cattle: Female breeding cattle are managed in mobs of greater than 500 cattle.	
Herd Size	whether the herd is above or below what is considered a viable herd size by McCosker *et al*	Am wondering whether we would have a risk factor which define whether beef cattle breeding is the primary business or not and
Primary activity of enterprise	Weaners Feeders Bullocks	
Do cull cows contribute a main source of income for the enterprise	Yes No	
Mustering inefficiency	<2.5% 2.5-5.0% >5.0%	Mustering inefficiency was estimated using absenteeism within mobs at musters. Missing animals (potential mortalities) were excluded from estimate. Absenteeism per mob mustered was summarised by property and quantiled to three groups, the resulting ranges of these were 0-2.44%; 2.46-6.1% and >6.1. For ease of interpretation these groups were rounded to <2.5%; 2.5-5% and >5%.
Reported aerial assistance during mustering.	Aerial assistance No aerial assistance	Aerial assisted: mustering occurred with the assistance of, or is completed by, the use of aerial vehicles such as a helicopter or aeroplane.
		Trapping: mustering occurs with the use/or assistance of infrastructure that has been put in place to gather and hold cattle, such as trap yards. If trapping has been used in conjunction with assistance from air vehicles, mustering was categorized as aerial assisted.
Method of mustering for PD and Wet/ Dry muster	Ground: mustering was conducted from the ground.	
Proportion of females predicted to have calved around the time of a muster	Low: <2% Medium: 2-5% High: >5%	Was defined as minus 1-month to plus 2-months *Thresholds to be defined futher*
Mustered around the time of expected calving	Mustered	Breeding females were recorded as being processed 1-month prior and 2 months

	Not Mustered	after expected month of calving)
Normal behavioural contact	Likely Not Likely	This risk factor is the likelihood of animals being normal behavioural contact with other animals during calving and shortly after calving. Interaction between area within 2.5km from water and stock numbers.
Bull:female ratio	<2% 2-3% ≥4%	
Bull genotype	Not tropically adapted Tropically adapted composite *Bos indicus*	
Replacement bull selection policy	nil best practice some best practice (at least 2 of the following – note BBSE not included; vaccinated for tick fever [if required] and BEF, BCS managed, bulls introduced in cooler months, allowed ≥2 months to acclimatize) mostly best practice (bulls selected on basis of having passed BBSE and at least 2 of the following; vaccinated for tick fever [if required] and BEF, BCS managed, bulls introduced in cooler months, allowed ≥2 months to acclimatize)	
Annual bull management policy	nil best practice some best practice (at least 2 of the following - note BBSE not included; same age bulls mated, vaccinated for BEF annually, BCS managed, treated for external internal parasites annually, bulls culled at ≥8years of age) mostly best practice (BBSE annually and at least 3 of the following; same age bulls mated, vaccinated for BEF annually, BCS managed, treated for external internal parasites annually, bulls culled at ≥8years of age)	
Heifer selection policy	Nil: All female weaners retained and exposed to bulls. Visual only: The draft of heifers exposed to bulls was selected only on visual appearance. The animals excluded are not thought to	YES (the heifers were adequately grown to attain puberty) – should this be best practice replacement heifer management used

	be sub-fertile in comparison to the animals retained. Pregnancy status prior to joining: The draft of heifers exposed to bulls was selected on pregnancy status prior to joining. Live weight: The draft of heifers exposed to bulls was selected on live weight or live weight gain performance prior to joining (with or the without the use of scales).	
Female culling rate for subfertility/infertility	<7% Low 7-15% Average >15% High	
Mating system	Control mated for ≤3 months: defined as bulls being deliberately exposed to females for a period less than 4 months. Control mated between 4-7 months: defined as bulls being deliberately exposed to females for a period between 4-7 months of the year. A common example is bulls removed at 2nd round and re-introduced early New Year. Continuously (>7m) mated without segregation: deliberately exposed to bulls for >7m of a year Continuously (>7m) mated with segregation: deliberately exposed to bulls for >7m of a year with breeders segregated on either lactation or stage of pregnancy. Note: Properties, that segregate mobs on stage of pregnancy and introduce and remove bulls at strategic times will also be categorised as continuously mated with segregation and footnoted.	
Number of years current property manager has been employed	<2 2-5 >5	
Vaccination for leptospirosis	Whole herd Heifers only Nil	
Vaccination for vibriosis	Heifers and Bulls	

	Bulls only Nil	
Vaccination for BEF	Whole herd Heifers only Nil	
Vaccination for botulism	Yes No	
Vaccination for tick fever	Yes No	
Vaccination for BVDV	Whole herd Heifers only Nil	
Prevalence of BVDV (pestivirus) infection	low moderate high Vaccinated	– are we going to look at these by year i.e 2009 and 2011or combined
Prevalence of recent BVDV (pestivirus) infection	low moderate high Vaccinated	
Prevalence of vibriosis	low moderate high Vaccinated	
Prevalence of L. hardjo infection	low moderate high Vaccinated	
Prevalence of recent L. hardjo infection	Low Moderate High Vaccinated	
Prevalence of L. pomona infection	low moderate high Vaccinated	
Prevalence of recent L. pomona infection	Low Moderate High Vaccinated	
Prevalence of N.caninum	low	

	moderate high	
Prevalence of Q-fever infection	low moderate high	
Prevalence of BEF infection	low moderate high Vaccinated	
Change in prevalence of BVDV (pestivirus) infection	No significant change or decrease Moderate change Large change	
Change in prevalence of N. caninum	No significant change or decrease Moderate change Large change	
Change in prevalence of L. hardjo infection	No significant change or decrease Moderate change Large change	
Change in prevalence of recent L. hardjo infection	No significant change or decrease Moderate change Large change	
Change in prevalence of L. pomona infection	No significant change or decrease Moderate change Large change	
Change in prevalence of recent L. pomona infection	No significant change or decrease Moderate change Large change	

Appendix X. **Summary of observed intercalving intervals**

The intercalving interval is the duration between successive calvings and usually has some degree of censoring of data as sub-fertile cattle are often culled prior to becoming pregnant. For this reason, outcomes such as pregnancy within a defined period from calving are a more robust measure of performance. Intercalving intervals are still widely referred to within industry to define performance; with the target being one calf per year. As there was some concern over the use of the outcome 'pregnant within four months of calving' and not pregnant within three months of calving (consistent with a 12 month intercalving interval) the following collation of frequency distributions of the observed intercalving intervals for different mating systems was generated.

In discussion with industry stakeholders, where individual identification of animals has not been implemented and females grouped or managed so that they calved in a two to three month window, cows that calved in the same window the following year were often referred to as having a 12 month intercalving interval. This assumption will be incorrect for a proportion of the females, as a number of cattle that have greater than a 12 month intercalving interval can still contribute a calf in the same calving window the following year. Examination of Beef CRC records indicated that for those cows that calved in the same three-month window in consecutive years the percentage of cows conceiving within two, three, or four months of calving was 17%, 64% and 90%, respectively.

In this section the intercalving intervals have been summarised by animal age class and mating management. Mating management has been summarised using four categories:

- *Control mated for ≤3 months* ***[<=3m]***: defined as bulls being deliberately exposed to females for a period less than four months.
- *Control mated between 4-7 months* ***[4-7m]***: defined as bulls being deliberately exposed to females for a period between four to seven months of the year. A common example is bulls removed at the second round and re-introduced early in the new year.
- *Continuously (>7m) mated without segregation* ***[seg]***: deliberately exposed to bulls for greater than seven months of a year.
- *Continuously (>7m) mated with segregation* ***[>7m]***: deliberately exposed to bulls for greater than seven months of a year with breeders segregated on either lactation or stage of pregnancy. Note: Properties, that segregate mobs on stage of pregnancy or lactation and introduce and remove bulls at strategic times were categorised as continuously mated with segregation.

As would be expected, the duration of mating affected the pattern of intercalving intervals, but surprisingly, the pattern for mobs mated for less than or equal to three months was similar to that of mobs mated for four to seven months. Some possible explanations for this are bulls on some properties are mated for longer than the desired three months, errors associated with foetal ageing, or time of bulls being mated varies between years on some properties.

In most cases a distinct peak in calving interval was observed, except for the Northern Forest where there typically were two smaller peaks about three to five months apart, most likely reflecting the impact of weaning on conceptions. Also, examination of the pattern of intercalving intervals by animal age class and country type indicates that in reality the peak interval is between about 12 to 13 months, supporting the use of the measure 'percentage pregnant within four months of calving'.

Using the measure 'percentage pregnant within three months of calving' would underestimate the population of cows described by the observed peak in calving pattern. Typically for cows, only 25 to 30% of intercalving intervals were 12 months, except in the Northern Forest where it was only 15%. It is difficult to make any firm conclusion about the impact of the use of segregation in the Northern Downs on the pattern and frequency of intercalving intervals. However, it is critical to recognise that calculation of intercalving intervals ignores those females which have failed to reconceive after calving, and therefore the impact of this management system on mob reproductive performance should not be judged solely from analysis of intercalving intervals.

Intercalving interval between first and second calving

The following section summarises specifically the interval between cows calving for the first time (first-lactation cows) until they calve for the second time (second-lactation cows). Distribution plots of intercalving intervals have been presented overall for each mating system (**Figure O**) and for each different mating system by country type (**Figure P**, **Q, R, S**).

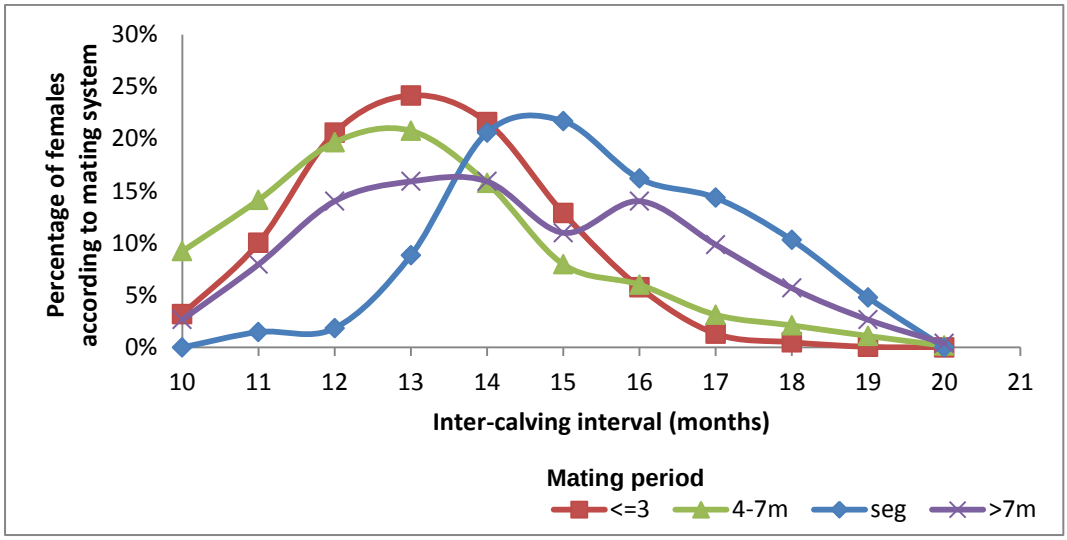


Figure O: Distribution of intercalving intervals between first and second calving by mating system.

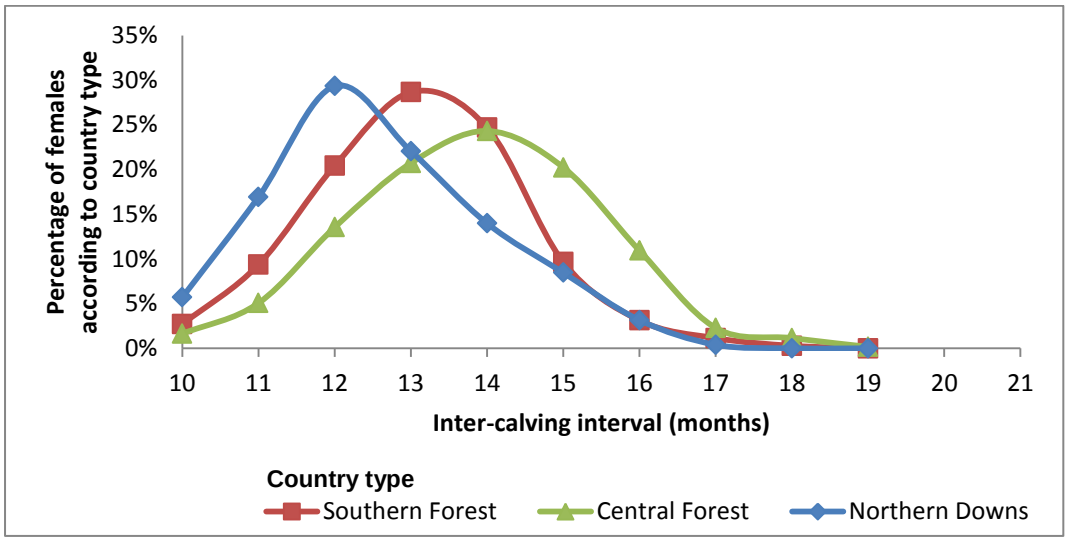


Figure P: Distribution of intercalving intervals between first and second calving reportedly mated for ≤3 months. Note Northern Forest is not presented due to no mobs reportedly mated for ≤3 months.

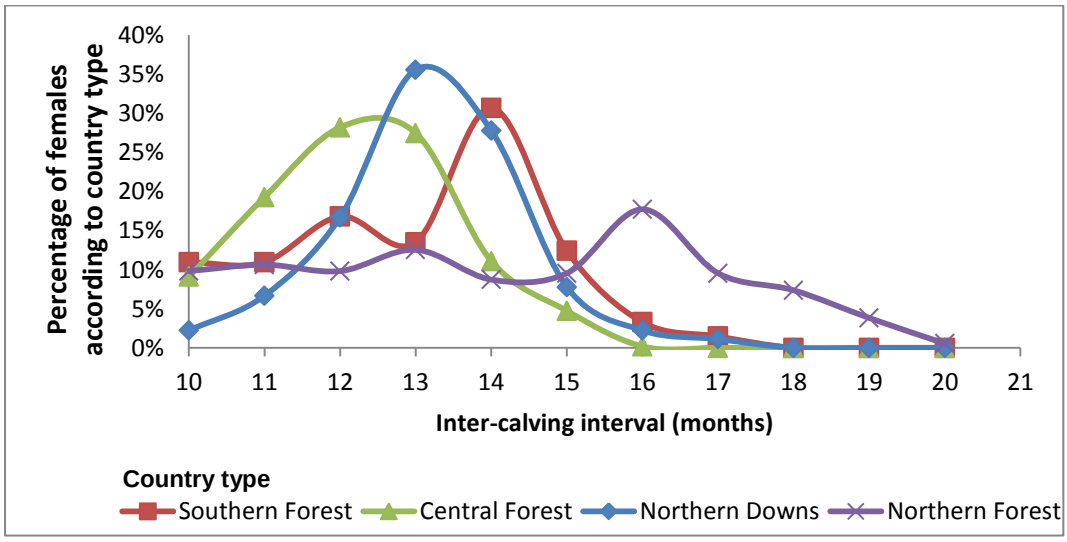


Figure Q: Distribution of intercalving intervals between first and second calving reportedly mated for between 4-7 months.

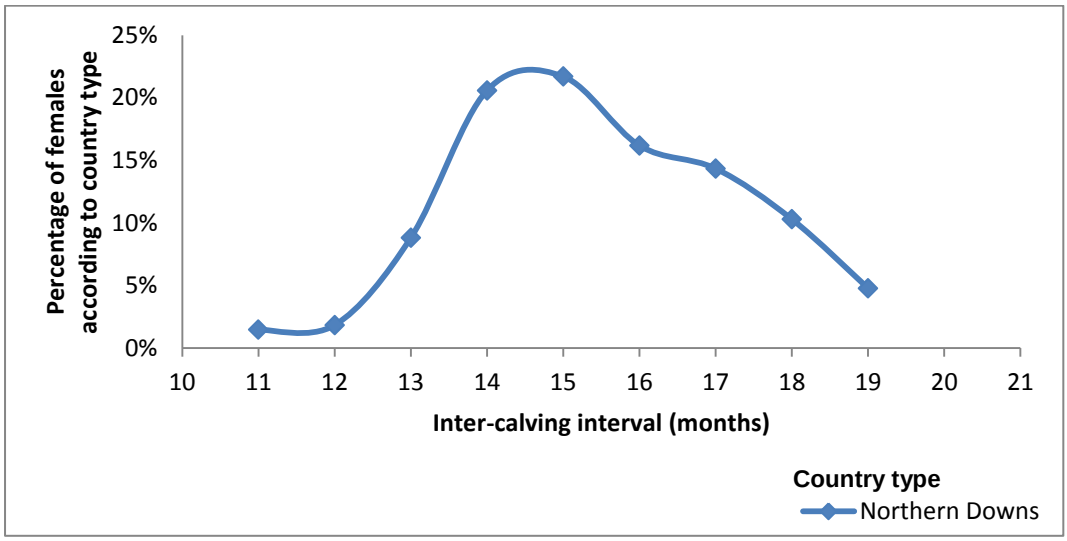


Figure R: Distribution of intercalving intervals between first and second calving reportedly mated for >7 months with segregation. Note Southern, Central and Northern Forest are not presented as no mobs were reportedly mated for >7 months with segregation.

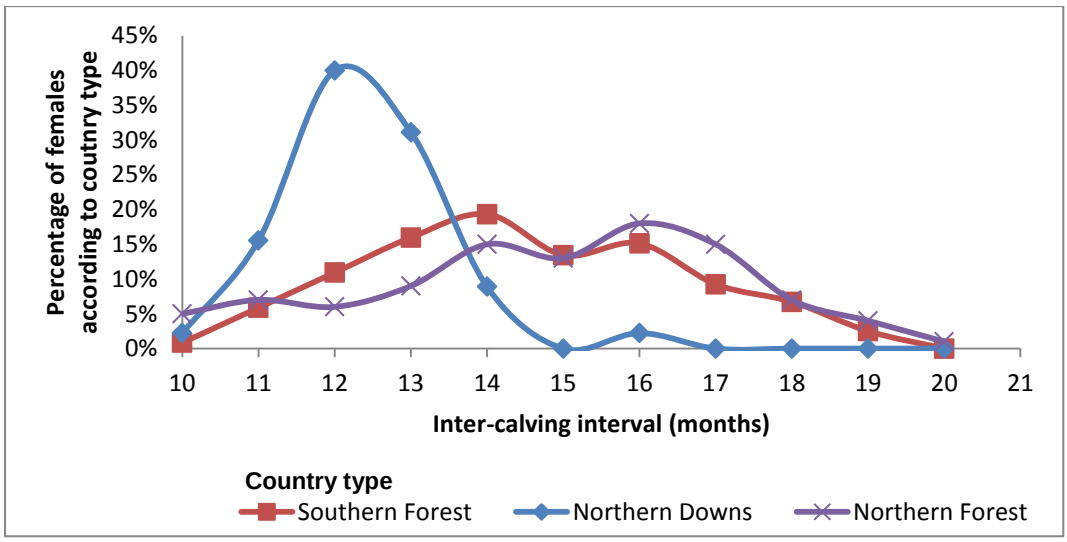


Figure S: Distribution of intercalving intervals between first and second calving reportedly mated for >7 months without segregation. Note Central Forest is not presented due to no mobs reportedly mated for >7 months without segregation.

Intercalving interval between second and third calving

The following section summarises the distribution of intercalving intervals for cows between their second and third calving. Distribution plots are presented overall for each mating system (**Figure T**) and for each mating system by country type (**Figure U**, **V, W, X**).

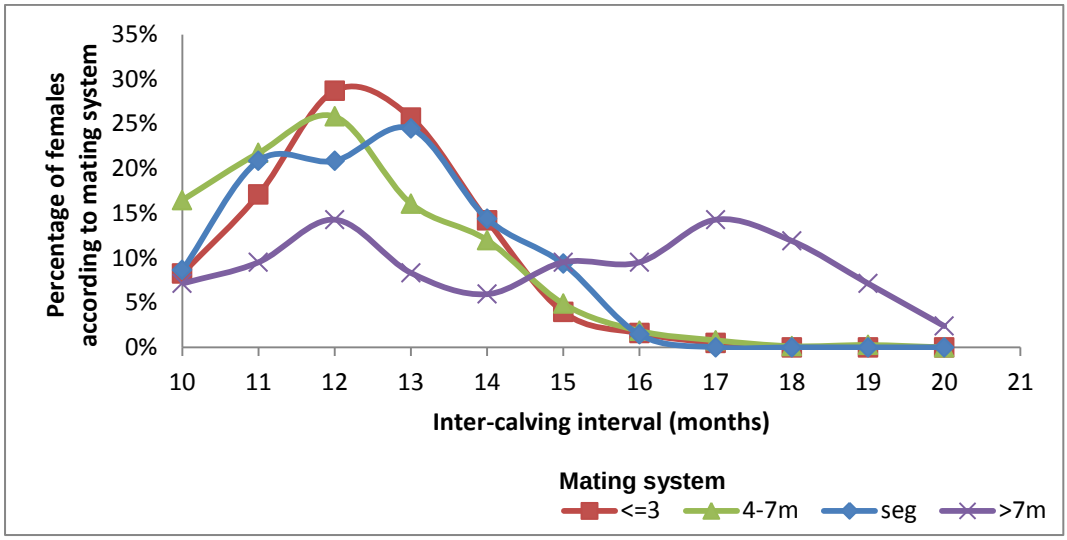


Figure T: Distribution of intercalving intervals between second and third calving by mating system.

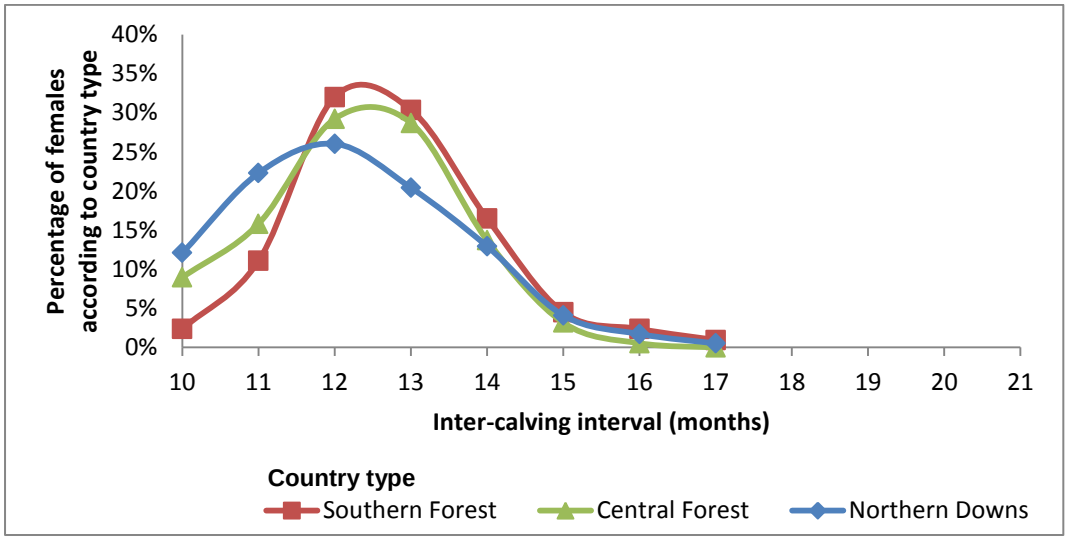


Figure U: Distribution of intercalving intervals between second and third calving reportedly mated for ≤3 months. Note Northern Forest is not presented due to no mobs reportedly mated for ≤3 months.

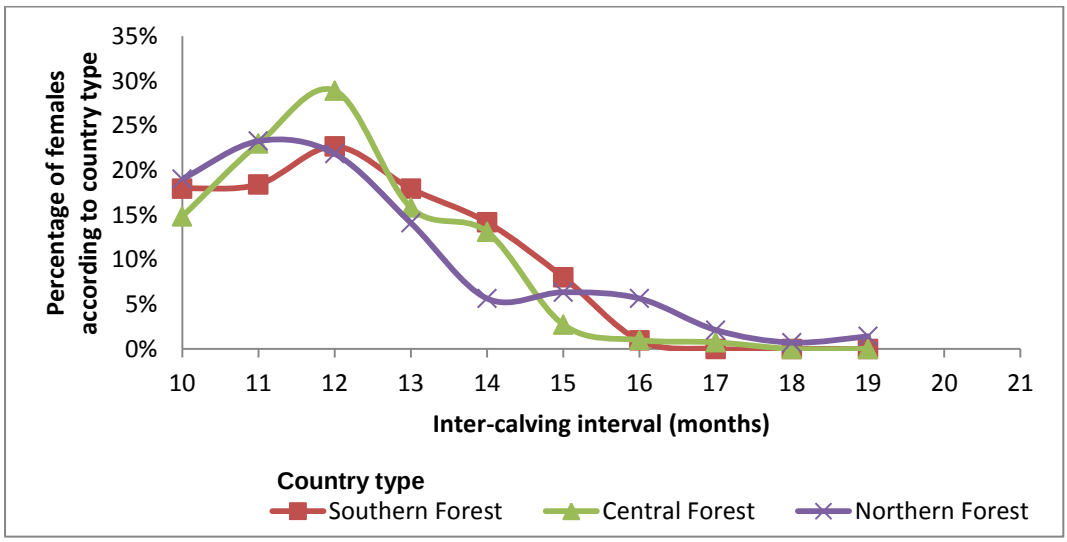


Figure V: Distribution of intercalving intervals between second and third calving reportedly mated for 4-7 months. Note Northern Downs is not presented due to no mobs reportedly mated for between 4-7 months.

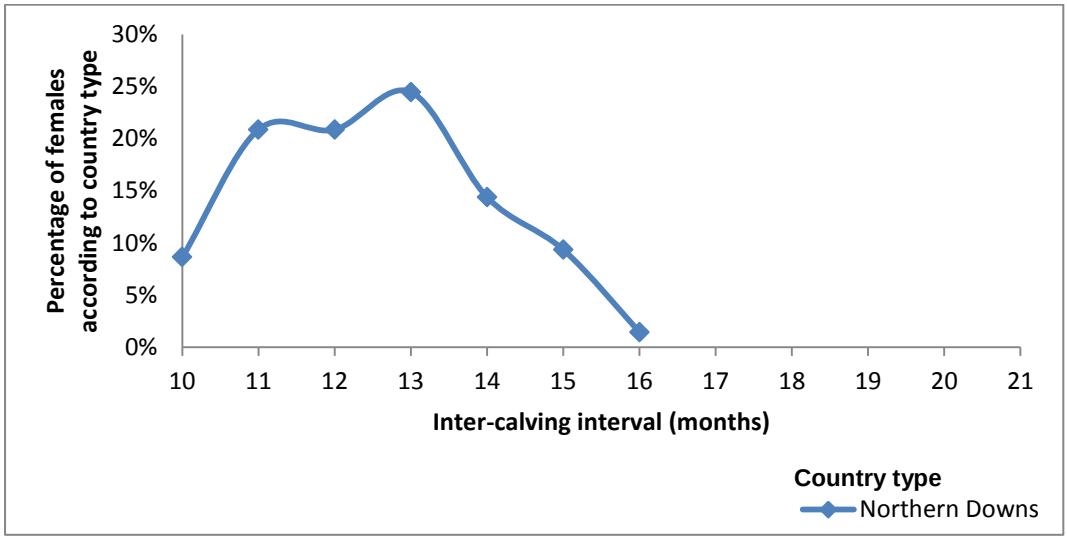


Figure W: Distribution of intercalving intervals between second and third calving reportedly mated for >7 months with segregation.

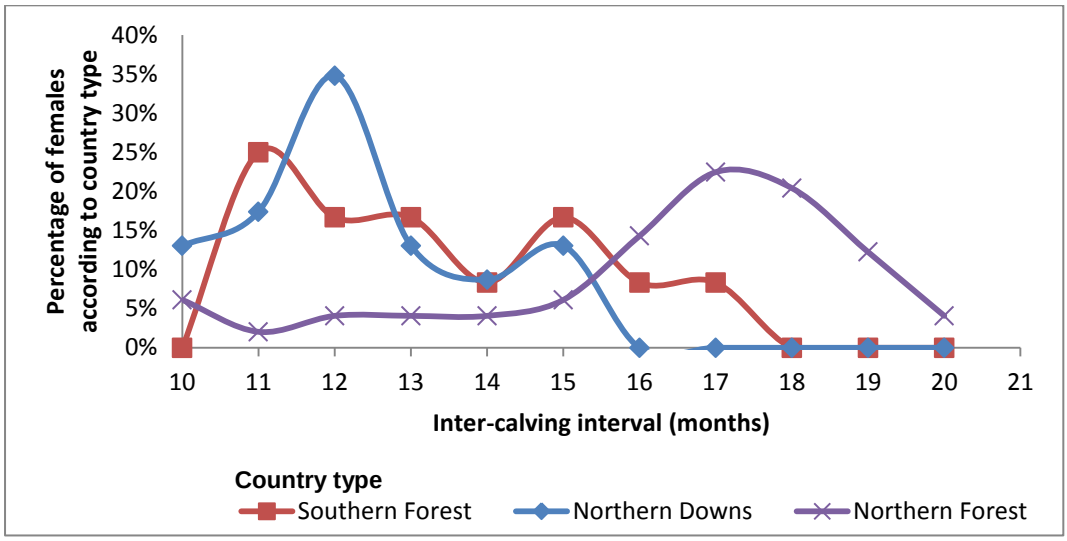


Figure X: Distribution of intercalving intervals between second and third calving reportedly mated for >7 months without segregation. Note Central Forest is not presented due to no mobs reportedly mated for >7 months without segregation.

Intercalving interval in cows

The following section summarises the distribution of intercalving intervals for multiparous cows. Distribution plots are presented overall for each mating system (**Figure Y**) and for each mating system by country type (**Figure Z**, **AA, BB, CC**).

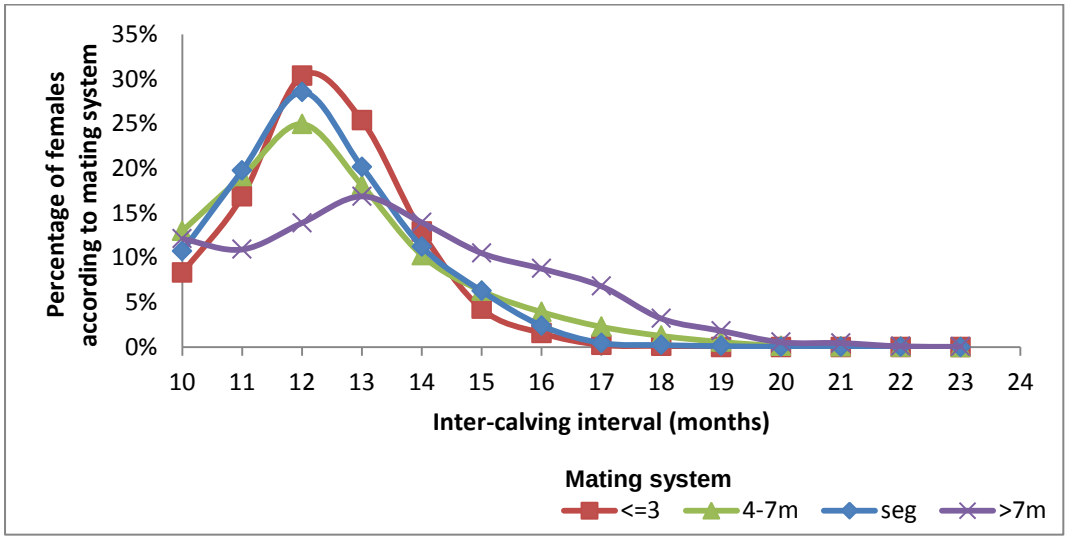


Figure Y: Distribution of intercalving intervals for cows by mating system

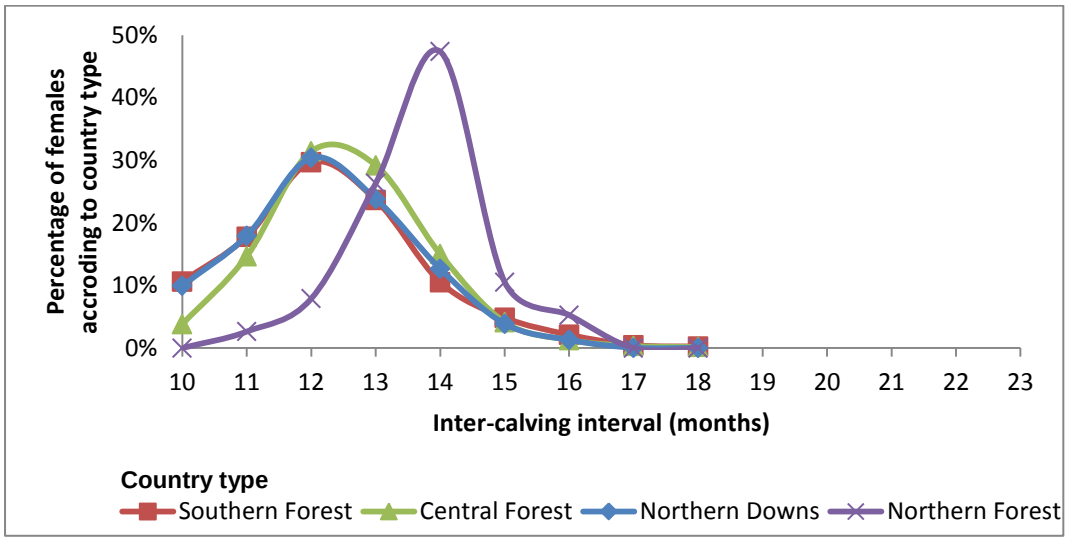


Figure Z: Distribution of intercalving intervals for cows reportedly mated for ≤3 months.

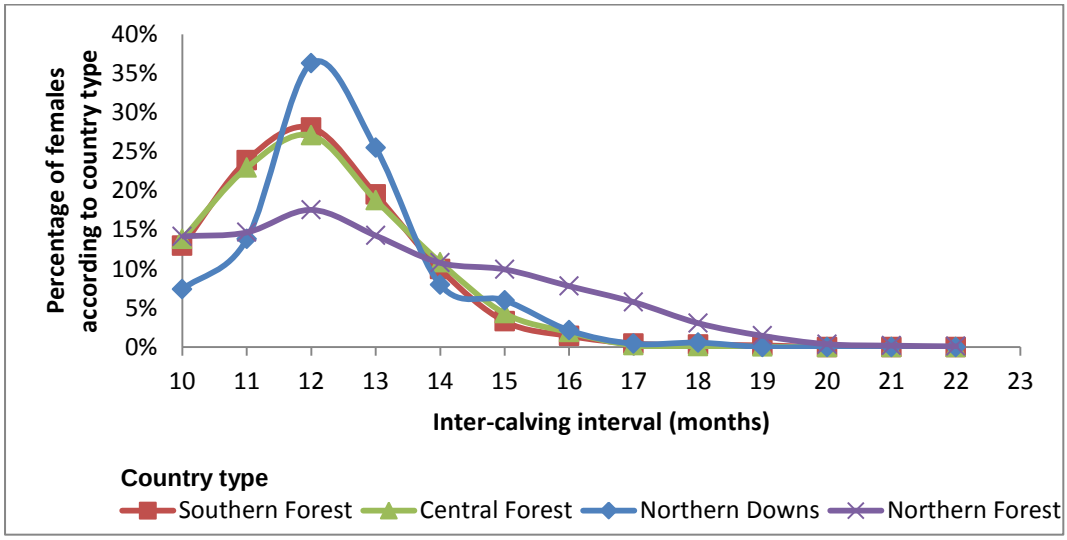


Figure AA: Distribution of intercalving intervals for cows reportedly mated for 4-7 months.

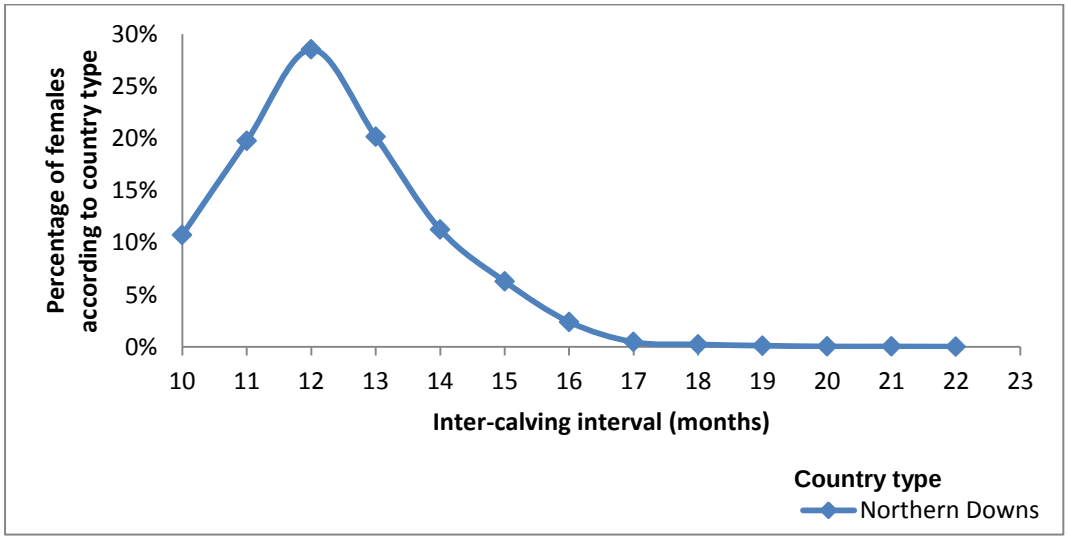


Figure BB: Distribution of intercalving intervals for cows reportedly mated for >7 months with segregation.

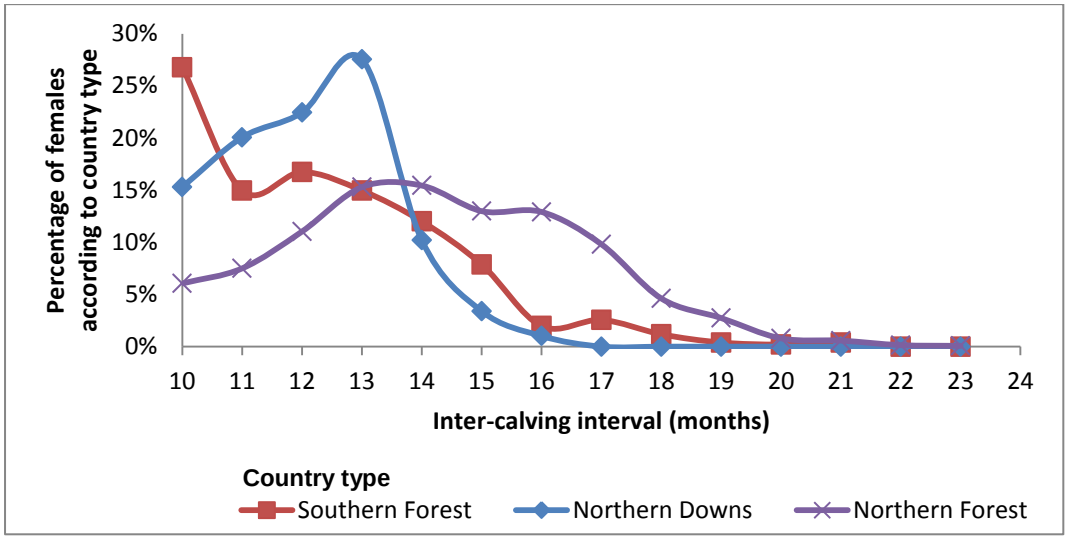


Figure CC: Distribution of intercalving intervals for cows reportedly mated for >7 months without segregation.

Appendix XI. **Example Management Survey**

CHAPTER 9.2

Management Survey '08-09'

Page 1

Property Details

1. Property Code:*
   eg. CC77P

2. Longitude and Latitude of Homestead
   Complete in degrees eg. Lat: -20.035 Long: 137.493

	Longitude	Latitude
Homestead (degrees)		

3. All PIC numbers associated with property (including any changes due to amalgamation)

PIC 1

PIC 2

PIC 3

4. Property Size
   (1 hectare = 2.47 acres; 100 hectares = 1 km2)

km2

hectares

acres

5. Estimated property value

$ per ha

$ per beast area

6. Period owned by by current owners?

7. Number of Years Manager has been employed?

8. Property's average annual rainfall (mm)

9.
Water is generally supplied to stock from which of the following?

- Dams/Rivers/Creeks (catchment and runoff)
- Bores

10. Toxic, noxious and other weeds that may cause a problem to productivity?

Identification	
Treatment or preventative measures	

11. Commonly encountered diseases in cattle

Identification	
Treatment or preventative measures	

12. Do you have a significant tick population?

Yes No

13. What (if any) is your tick control program?

14. Wildlife that may affect productivity (stocking rates, diseases, predation)

Identification	
Treatment or preventative measures	

15. Do you consider dingo's are having an impact on the productivity of your breeding herd?

Yes No

16. What (if any) measures are taken to control dingo's?

Property Personnel Details

Names and Positions of Employees that will be involved with various parts of the project

(mostly applicable to company properties with large staff numbers)

17. Stock Management including paddock book (stock numbers)

- Name
- Position

18. Data Recording

- Name
- Position

19. Supplementary Feeding

- Name
- Position

20. Environmental/Rangeland Monitoring

- Name
- Position

21. Rainfall

- Name
- Position

Enterprise Details

22. Any recent or future significant changes to management of the property?

23. Average totalherd size on the property (as at June 2008)

	Current	Objective
Breeders (Cow/Calf unit)		
Bulls		
Weaners		
heifers prior to joining		
Bullocks		

Overall Herd Management Details

24. Mustering Techniques
Select all that apply

- Helicopter
- Motorbikes
- Planes
- Horses
- Trapping
- Other, please specify

25. Estimated Mustering efficiency (%)
The value must be between 0 and 100, inclusive.

26. Main factors affecting mustering efficiency

- Weather
- Personnel
- Tree Cover
- Certain paddocks
- Time of Year
- Other, please specify

27. Boundary fence security and freqency of 'stranger cattle' on property?

- Excellent
- Good
- Average
- Fair
- Poor

28. Managment System

- Controlled
- Continuous
- Segregation on pregnancy
- Segregation on lactation
- Other, provide details and if controlled - how many months

29. Biosecurity (do breeders have contact with external cattle other than bulls?)

- Yes
- No

30. On the property where the breeders are run, what is the average weight gain per year of yearlings (steers or heifers)?
(kgs)

Heifer Management

Heifer Management Post Weaning to Joining

31. Describe monthly activities

	Dry-Sup	Wet-Sup
Jan		
Feb		

Mar		
Apr		
May		
Jun		
Jul		
Aug		
Sep		
Oct		
Nov		
Dec		

32. Describe supplementary feeding

33. Describe vaccinations and other treatments

Jan	
Feb	
Mar	
Apr	
May	
Jun	
Jul	
Aug	
Oct	
Nov	
Dec	

34. Paddocks (General Description)

35. Security from Bulls

- Very Good
- Good
- Average
- Bad
- Very Bad

36. Other

Joiner heifer selection protocol

37. Joiner heifer selection protocol

Time of year (month):	
average age of heifers at selection:	
Weight (kg):	

38. Type (what are you looking for)

39. Combination (specify)

Management Joining to Weaning

40. Describe monthly activities

	Mating	Calving	Branding	Weaning	PregTest	Dry-Sup	Wet-Sup

Jan							
Feb							
Mar							
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							

41. Supplementary Feeding

42. Describe vaccinations and other treatments

Jan	
Feb	
Mar	
Apr	
May	
Jun	
Jul	
Aug	
Oct	
Nov	
Dec	

43. Paddocks (General Description)

44. Other

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Mature Breeder Management

45. Describe monthly activities

	Mating	Calving	Branding	Weaning	PregTest	Dry-Sup	Wet-Sup
Jan							
Feb							
Mar							
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							

46. Describe vaccinations and other treatments

Jan	
Feb	
Mar	
Apr	
May	
Jun	
Jul	
Aug	

Oct

Nov

Dec

47. Age Structure of Breeding Herd (if available)

	Proportion of Herd
Yearling	
2 yo	
3 yo	
4 yo	
5 yo	
6 yo	
7 yo	
8 yo	
9 yo	
10+ yo	

48. Culling Age

49. Weaning

Age

Date (approx)

Does this vary with season (yes/no)

50. Dominant Months of Calving

Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun

51. Main Income Generator

- Sale of Weaners
- Sale of Feeder Heifers and Steers
- Sale of cull cows and bulls
- Sale of bullocks
- Other, please specify

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Genetic Strategy

52. Objective of Genetic Strategy

- Environmental adaptation
- Markets
- Profitability
- Other, please specify

53. Breeds

54. Mechanism

- Stable breed
- 2- or 3-way cross
- Composite
- ad hoc
- Other, please specify

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Recent/Current subfertility investigations

55. Have any recent invesitgations into causes of lower than expected reproductive performance of breeder mobs been conducted on this property?

- Yes
- No

56. If yes to the previous question, what were the major findings?

Tools and External influences

57. Tools and external influences used to improve profitabilty (provide details)

Herd Modelling	
Key profit indicators	
RCS	
QDPI	
Courses	
Other	

Diary Entries

58. Ares unusual health issues or deaths recorded in the diary (eg. aborted foetuses, unusual weahter events)?

- Yes
- No

59. Will project management be allowed access to the diary?

- Yes
- No

Supporting Data

60. Is there any previous data available and can the project management team have access to it?

	Data Available (Yes/No)	Access Allowed (Yes/No)
Herd Number and		

Structure		
Turn off numbers and weights		
Deaths		
Environmental/ rangelands data		
Nutritional data		

61. Other comments relating to data available
    eg. could be what programs currently has data stored.

Appendix XII. **Factors affecting P4M – final model**

Variable	Level	No. obs in final model (n)	Coefficient	p-value	95% Co Lowe
Country-type				**<0.001**	
	Northern Downs*	8,468	Referent level		
	Southern Forest	3,982	0.91	0.03	0.088
	Central Forest	5,626	0.37	0.37	-0.433
	Northern Forest	4,815	-1.664	<0.001	-2.399
Year				**<0.001**	
	2008-2009*	1,507	Referent level		
	2009-2010	11,057	0.222	0.03	0.017
	2010-2011	10,327	0.479	<0.001	0.246
Animal age class				**<0.001**	
	Mature cows*	12,880	Referent level		
	First-lactation cows	4,135	-1.226	<0.001	-1.439
	Second-lactation cows	2,405	-0.226	0.04	-0.445
	Aged cows	3,471	0.0579831	0.403	-0.07791
Period of calving in the previous reproductive cycle				**<0.001**	
	Oct-Nov*	8,063	Referent level		
	Jul-Sep	3,324	-1.573	<0.001	-1.692
	Dec-Jan	8,450	0.735	<0.001	0.645
	Feb-Mar	2,379	0.383	<0.001	0.253
	Apr-Jun	675	-0.085	0.42	-0.291
Body condition score at pregnancy diagnosis muster				**<0.001**	
	3.0*	6,358	Referent level		
	1.0-2.0	1,645	-0.700	<0.001	-0.915
	2.5	2,152	-0.263	0.01	-0.459
	3.5	5,967	0.471	<0.001	0.332
	4.0-5.0	6,769	0.580	<0.001	0.432
Average CP:DMD during the wet season (Nov-Apr)				**<0.001**	
	≤0.125*	6,205	Referent level		
	>0.125	16,686	0.308	<0.001	0.171
Average FP:ME during the wet season (Nov-Apr)				**0.027**	
	≤500 mg P/MJ ME*	13,652	Referent level		
	>500 mg P/MJ ME	9,239	0.165	<0.001	0.019
Average change in BCS between PD to WD musters				**<0.001**	

	Lost or Maintained*	20,281	Referent level		
	Gained	2,610	0.329	<0.001	0.231
Interaction: BCS at PD muster x Country-type				**<0.001**	
BCS at PD muster	**Country-type**				
1 to 2	Southern Forest	376	0.192	0.31	-0.181
1 to 2	Central Forest	269	0.166	0.42	-0.239
1 to 2	Northern Forest	273	0.085	0.70	-0.340
2.5	Southern Forest	347	-0.160	0.37	-0.511
2.5	Central Forest	415	0.125	0.44	-0.195
2.5	Northern Forest	586	0.107	0.50	-0.205
3.5	Southern Forest	1,081	-0.317	0.02	-0.583
3.5	Central Forest	1,490	-0.252	0.03	-0.477
3.5	Northern Forest	1,229	-0.619	<0.001	-0.864
4 to 5	Southern Forest	1,216	-0.165	0.26	-0.451
4 to 5	Central Forest	1,954	-0.332	0.01	-0.569
4 to 5	Northern Forest	1,200	-0.560	<0.001	-0.82
Interaction: Animal age class x Country-type				**<0.001**	
Animal age class	**Country-type**				
First lactation cows	Southern Forest	959	0.375	0.02	0.066
First lactation cows	Central Forest	1,332	0.308	0.03	0.028
First lactation cows	Northern Forest	1,118	0.257	0.12	-0.064
Second lactation cows	Southern Forest	627	0.180	0.24	-0.117
Second lactation cows	Central Forest	737	0.414	0.01	0.124
Second lactation cows	Northern Forest	203	-0.678	<0.001	-1.111
Aged cows	Southern Forest	345	0.080	0.65	-0.268
Aged cows	Central Forest	536	-0.103	0.49	-0.397
Aged cows	Northern Forest	821	-0.080	0.55	-0.345
Interaction: Animal age class x Average FP:ME during the wet season				**<0.001**	
Animal age class	**Average FP:ME**				
First lactation cows	>500 mg P/MJ ME	2,203	0.930	<0.001	0.687
Second lactation cows	>500 mg P/MJ ME	4,703	-0.133	0.28	-0.375
Aged cows	>500 mg P/MJ ME	1,007	0.217	0.09	-0.032
Intercept			-0.474	0.15	-1.125
Random effect			**Std dev**		**95% C**
					Lowe
Level 2 (property)			0.889		0.596
rho (ICC)			0.213		0.153

(* referent level)

Appendix XIII. **Estimated weight gain required for a female to gain 0.5 BCS**

To estimate the change in live weight per unit body condition score (using a 5 point scale) a simple linear regression analysis adjusted for effects at the property level was used. Body condition score assessment and live weight data collected at both WD and PD musters were pooled. The live weight data was not adjusted for pregnancy or curfew period at the time of measurement. This analysis estimated a unit change in BCS was approximately a 45 kg change in live weight. Therefore, approximately 22.5 kg gain in live weight was predicted to be required to gain 0.5 BCS. The coefficient of determination for this regression was 0.23.

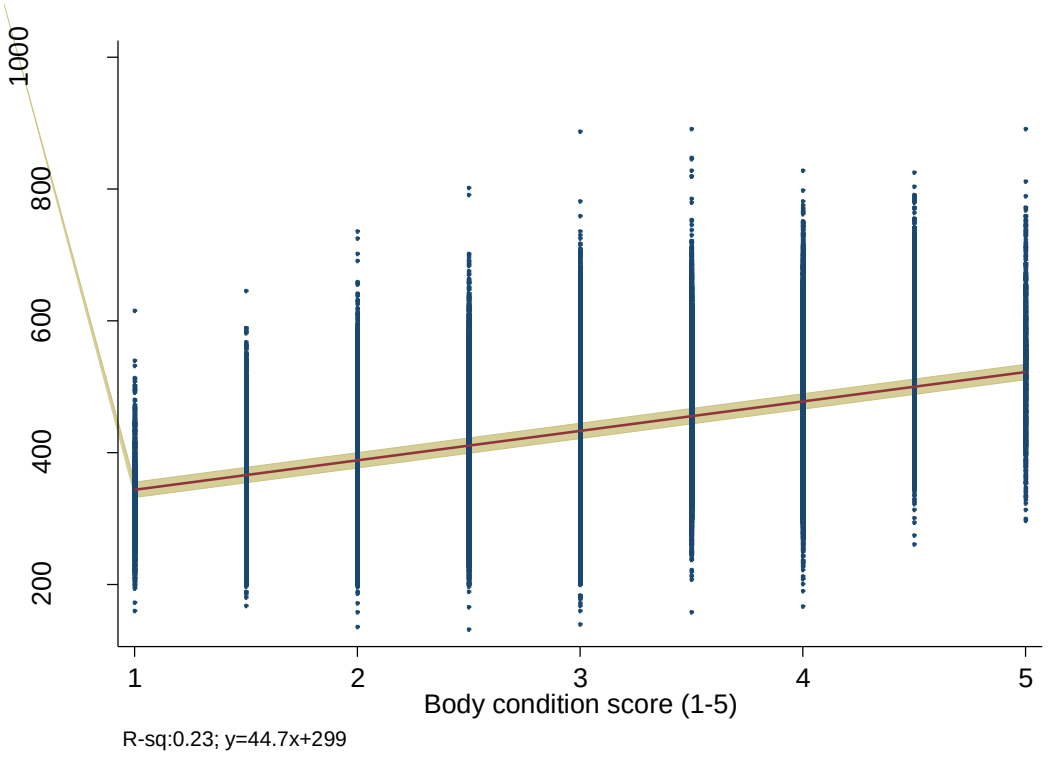

Figure DD: Regression of body condition score as a predictor of live weight (kg).

Appendix XIV. **Factors affecting annual pregnancy rate – final model**

Variable	Level	No. obs in final model (n)	Coefficient	p-value	95% CI Lower	95% CI Upper
Animal age class				**<0.001**		
	1st lactation	6,747	Referent level			
	Mature cow	19,135	-0.986	<0.001	-1.20	-0.77
	Aged cow	6,500	0.079	0.47	-0.14	0.30
Previous reproductive outcome				**<0.001**		
	Oct-Nov	8,536	Referent level			
	Jul-Sep	3,573	0.372	0.006	0.11	0.64
	Dec-Jan	9,258	-0.284	0.002	-0.46	-0.11
	Feb-Mar	2,766	-1.268	<0.001	-1.49	-1.05
	Apr-Jun	826	-2.168	<0.001	-2.45	-1.89
	Pregnant	1,846	-1.492	<0.001	-1.74	-1.25
	Empty	3,897	1.159	<0.001	0.85	1.46
	FTR	1,680	0.076	0.727	-0.35	0.50
Year				**<0.001**		
	2009	2,138	Referent level			
	2010	19,546	-0.250	0.034	-0.48	-0.02
	2011	10,698	-0.540	<0.001	-0.79	-0.29
DMD at the dry period				**<0.001**		
	≤ 55	28,054	Referent level			
	> 55	4,328	0.797	<0.001	0.53	1.06
PME ratio in previous wet				**0.01**		
	≤500mgP/MJME	21,266	Referent level			
	>500mgP/MJME	11,116	-0.539	0.011	-0.96	-0.12
CP/DMD in previous wet				**0.26**		
	≤ 0.125	10,037	Referent level			
	> 0.125	22,315	0.162	0.246	-0.11	0.44
Country-type				**<0.001**		
	Northern downs	11,029	Referent level			
	Southern forest	4,322	1.628	0.002	0.58	2.67
	Central forest	6,359	0.652	0.116	-0.16	1.46
	Northern forest	10,672	-0.909	0.011	-1.61	-0.21

BCS at wet-dry muster				**<0.001**		
	3	10,643	Referent level			
	1 to 2	3,764	-1.417	<0.001	-1.62	-1.22
	2.5	5,068	-0.844	<0.001	-1.02	-0.67
	3.5	7,235	0.313	0.01	0.08	0.55
	4 to 5	5,132	0.034	0.817	-0.25	0.32
Interaction: PME in previous wet x CP/DMD in previous wet				**<0.001**		
PME	**CP/DMD**					
> 500	> 0.125	9,821	1.460	<0.001	1.14	1.78
Interaction: County-type x PME in previous wet				**<0.001**		
Country type	**PME**					
Southern forest	> 500	2,473	-0.559	0.006	-0.96	-0.16
Central forest	> 500	3,928	-0.264	0.116	-0.59	0.06
Northern forest	> 500	1,649	0.593	0.004	0.19	1.00
Interaction: Prev repro outcome x Animal age class				**<0.001**		
Pr. Repro o.	**Animal age class**					
Jul-Sep	Mature cow	1,581	-0.093	0.507	-0.37	0.18
Jul-Sep	Aged cow	520	-0.394	0.038	-0.77	-0.02
Dec-Jan	Mature cow	5,694	-0.026	0.813	-0.24	0.19
Dec-Jan	Aged cow	2,214	0.092	0.416	-0.13	0.31
Feb-Mar	Mature cow	1,650	0.061	0.699	-0.25	0.37
Feb-Mar	Aged cow	709	-0.100	0.478	-0.37	0.18
Apr-Jun	Mature cow	548	1.456	<0.001	0.76	2.15
Apr-Jun	Aged cow	230	-0.042	0.83	-0.43	0.34
Pregnant	Mature cow	1,288	0.127	0.601	-0.35	0.60
Pregnant	Aged cow	449	-0.457	0.002	-0.75	-0.16
Empty	Mature cow	2,463	0.775	<0.001	0.39	1.16
Empty	Aged cow	658	-0.808	<0.001	-1.15	-0.46
FTR	Mature cow	814	0.369	0.073	-0.03	0.77
FTR	Aged cow	278	-0.449	0.039	-0.88	-0.02
Interaction: BCS at wet-dry muster x Animal age class				**<0.001**		
BCS	**Animal ageclass**					
1 to 2	Mature cow	1,877	0.548	<0.001	0.30	0.80
1 to 2	Aged cow	835	-0.117	0.336	-0.36	0.12
2.5	Mature cow	3,162	0.164	0.148	-0.06	0.39
2.5	Aged cow	1,089	0.081	0.473	-0.14	0.30
3.5	Mature cow	4,342	0.434	0.002	0.16	0.71
3.5	Aged cow	1,408	-0.148	0.222	-0.39	0.09
4 to 5	Mature cow	3,183	0.655	<0.001	0.35	0.96
4 to 5	Aged cow	858	0.148	0.313	-0.14	0.44
Interaction: County-type x CP/DMD in previous wet				**<0.001**		
Country-type	**CP/DMD**					
Southern forest	> 0.125	4,180	-1.852	<0.001	-2.63	-1.07
Central forest	> 0.125	5,738	-1.686	<0.001	-2.14	-1.23

Northern forest	> 0.125	4,783	0.103	0.562	-0.24	0.45
Interaction: Prev repro outcome x BCS at wet-dry muster				**<0.001**		
Pr. repro o.	**BCS**					
Jul-Sep	1 to 2	477	0.548	0.003	0.19	0.91
Jul-Sep	2.5	935	0.274	0.077	-0.03	0.58
Jul-Sep	3.5	687	-0.090	0.671	-0.50	0.32
Jul-Sep	4 to 5	263	-0.023	0.939	-0.60	0.56
Dec-Jan	1 to 2	1,266	-0.159	0.194	-0.40	0.08
Dec-Jan	2.5	1,669	-0.114	0.31	-0.33	0.11
Dec-Jan	3.5	1,919	-0.266	0.069	-0.55	0.02
Dec-Jan	4 to 5	1,046	-0.147	0.397	-0.49	0.19
Feb-Mar	1 to 2	495	-0.037	0.822	-0.36	0.29
Feb-Mar	2.5	525	0.084	0.573	-0.21	0.38
Feb-Mar	3.5	537	-0.264	0.131	-0.61	0.08
Feb-Mar	4 to 5	169	0.051	0.84	-0.45	0.55
Apr-Jun	1 to 2	58	0.896	0.007	0.24	1.55
Apr-Jun	2.5	121	-0.445	0.111	-0.99	0.10
Apr-Jun	3.5	181	-0.553	0.012	-0.98	-0.12
Apr-Jun	4 to 5	61	-1.221	0.001	-1.94	-0.50
Pregnant	1 to 2	242	1.506	<0.001	1.13	1.88
Pregnant	2.5	377	0.443	0.009	0.11	0.77
Pregnant	3.5	360	-1.030	<0.001	-1.40	-0.66
Pregnant	4 to 5	362	-1.226	<0.001	-1.63	-0.82
Empty	1 to 2	44	0.712	0.105	-0.15	1.57
Empty	2.5	124	0.123	0.686	-0.47	0.72
Empty	3.5	1,442	0.094	0.637	-0.30	0.49
Empty	4 to 5	1,400	-0.528	0.011	-0.94	-0.12
FTR	1 to 2	37	-0.151	0.705	-0.94	0.63
FTR	2.5	63	0.546	0.138	-0.17	1.27
FTR	3.5	488	0.006	0.982	-0.51	0.52
FTR	4 to 5	861	-0.196	0.446	-0.70	0.31
Intercept			2.567	<0.001	1.91	3.22

Random effect	**Std dev**	**95% CI**	
		Lower	**Upper**
Level 2 (property)	0.862	0.70	1.06
rho (ICC)	0.184	0.13	0.25

Appendix XV. Factors affecting the percentage foetal/calf loss – final model

Variable	Level	No. obs in final model (n)	Coefficient	p-value	95% C Lowe
Country-type				**0.2**	
	Northern Downs*	6,705	Referent level		
	Southern Forest	5,588	-0.004	0.99	-0.71
	Central Forest	5,460	-0.047	0.9	-0.77
	Northern Forest	5,413	0.669	0.11	-0.13
Lactated in previous year				**<0.001**	
	Lactated*	13,177	Referent level		
	Did not lactate	9,989	0.315	<0.001	0.164
Hip height			**0.005**		
	125-140 cm*	15,975	Referent level		
	<125 cm	1,056	-0.169	0.15	-0.40
	>140 cm	6,135	0.157	0.01	0.049
Body condition score at pregnancy diagnosis muster				**<0.001**	
	3*	6,594	Referent level		
	1 to 2	2,066	-0.346	0.08	-0.73
	2.5	2,676	0.159	0.27	-0.12
	3.5	5,409	0.223	0.06	-0.00
	4 to 5	6,421	-0.324	0.01	-0.57
Animal age class				**0.11**	
	Mature cows*	11,810	Referent level		
	First lactation cows	6,173	0.192	0.03	0.021
	Second lactation cows	3,083	0.091	0.3	-0.08
	Aged cows	2,100	0.128	0.15	-0.04
Mustered within a month of calving				0.02	
	Not mustered*	20,490	Referent level		
	Mustered	2,676	0.233	0.02	0.030
Number of days THI>79 in expected month of calving				**<0.001**	
	<15 days*	9,309	Referent level		
	≥15 days	13,857	0.634	<0.001	0.328
Average FP:ME during wet season				**0.5**	
	≥500 mg P/MJ ME*	9,069	Referent level		
	<500 mg P/MJ ME	14,097	0.118	0.5	-0.22
Mustering efficiency				**0.03**	

	≥90 percent*	22,051	Referent level		
	<90 percent	1,115	0.789	0.03	0.08
Interaction: BCS at PD muster x Average wet season FP:ME				**<0.001**	
BCS at PD muster	**Average wet FP:ME**				
1 to 2	<500 mg P/MJ ME	1,272	0.415	0.06	-0.02
2.5	<500 mg P/MJ ME	1,596	-0.116	0.5	-0.45
3.5	<500 mg P/MJ ME	3,026	-0.453	<0.001	-0.72
4 to 5	<500 mg P/MJ ME	3,791	0.134	0.37	-0.16
Interaction: Animal age class x Mustered within a month of calving				**0.02**	
Animal age class	**Must. month. calv.**				
1st lactation cows	Mustered	535	0.399	0.02	0.06
2nd lactation cows	Mustered	375	-0.372	0.13	-0.84
Aged cows	Mustered	256	-0.064	0.78	-0.51
Interaction: Country-type x Calving month THI days>79				**<0.001**	
Country-type	**THI days>79**				
Southern Forest	≥15 days	848	-0.199	0.38	-0.63
Central Forest	≥15 days	2,373	-0.212	0.28	-0.59
Northern Forest	≥15 days	4,511	-0.691	0.001	-1.08
Interaction: Country-type x Average wet season FP:ME				**<0.001**	
Country-type	**Average wet FP:ME**				
Southern Forest	<500 mg P/MJ ME	2,112	-0.192	0.36	-0.6
Central Forest	<500 mg P/MJ ME	2,248	0.721	<0.001	0.32
Northern Forest	<500 mg P/MJ ME	4,760	0.204	0.44	-0.31
Intercept			-3.082	<0.001	-3.68
Random effect			**Std dev**		**95% Lowe**
Level 2 (property)			0.492		0.32
rho (ICC)			0.13		0.08

*Referent level

Appendix XVI. Factors affecting the prevalence of missingness (mortality) in breeding beef cattle in northern Australia

Variable	Level	No. obs in final model (n)	Coefficient	p-value	95% Confidence interva Lower	Upper
Country-type				**0.02**		
	Northern Downs*	8,888	Referent level			
	Southern Forest	3,591	0.210	0.44	-0.318	0.739
	Central Forest	4,957	0.276	0.29	-0.236	0.788
	Northern Forest	4118	0.705	<0.001	0.227	1.183
Body condition score at pregnancy diagnosis muster				**<0.001**		
	3.0*	6,452	Referent level			
	1.0-2.0	1,731	0.748	<0.001	0.508	0.987
	2.5	2,061	0.379	<0.001	0.143	0.615
	3.5	4,793	-0.115	0.26	-0.313	0.083
	4.0-5.0	6,517	-0.108	0.31	-0.318	0.102
Period of calving				**0.101**		
	Oct-Nov*	7,403	Referent level			
	Jul-Sep	3,794	0.186	0.01	0.04	0.332
	Dec-Jan	7,028	0.011	0.86	-0.119	0.142
	Feb-Mar	2,077	-0.044	0.64	-0.23	0.142
	Apr-Jun	1,252	0.097	0.41	-0.132	0.326
Minimum available biomass during the dry season				**<0.001**		
	≥2000 kg DM/ha*	7,740	Referent level			
	<2000 kg DM/ha	13,814	0.633	<0.001	0.302	0.964
Days to follow-up rain after season break				**0.04**		
	<30 days*	14,475	Referent level			
	≥30 days	7,079	0.335	0.04	0.017	0.653
Interaction: BCS at PD muster x Available dry season biomass				**0.03**		
BCS	**Available pasture**					
1 to 2	<2000 kg DM/ha	531	-0.546	<0.001	-0.913	-0.179
2.5	<2000 kg DM/ha	973	-0.265	0.11	-0.587	0.056
3.5	<2000 kg DM/ha	1859	-0.122	0.42	-0.419	0.175
4 to 5	<2000 kg DM/ha	2,907	-0.002	0.99	-0.308	0.304
Intercept			-5.521	<0.001	-5.95	-5.02
Random effect			**Std dev**		**95% Confidence Interva**	

		Lower	Upper
Level 2 (property)	0.332	0.206	0.535

*Referent level

Appendix XVIII. **Excerpt from CashCow report to co-operating producers benchmarking performance of their enrolled mobs**

Benchmarking Beef Production

Weaner Production

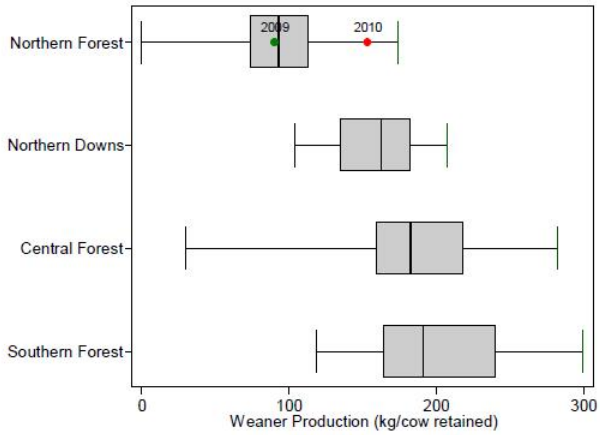

Figure 2. Variation in weaner production for each country-type.

Beef Production

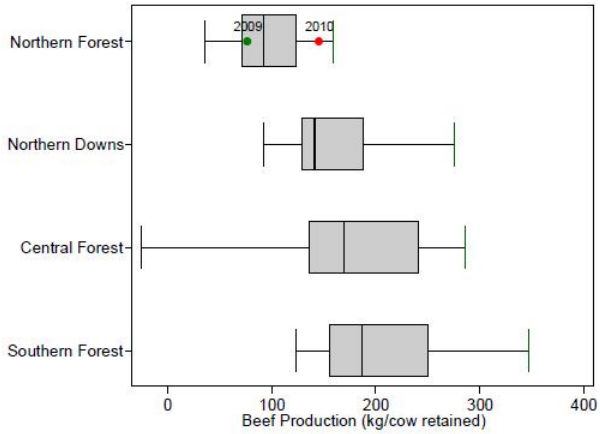

Figure 3. Variation in beef production for each country-type.

Benchmarking Reproductive Performance

In-calf within 4 months

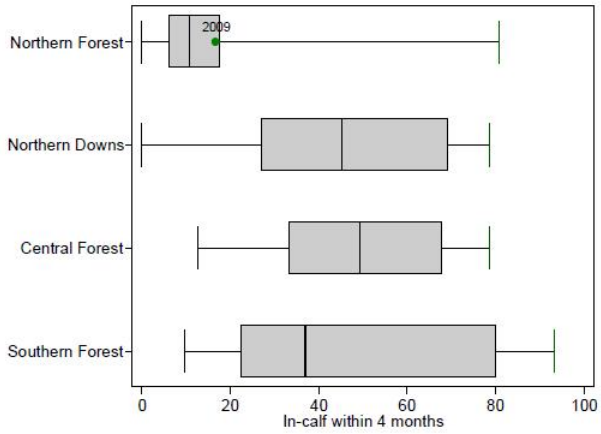

Figure 4. Percentage of 1st lactation cows in-calf within 4 months for each country-type.

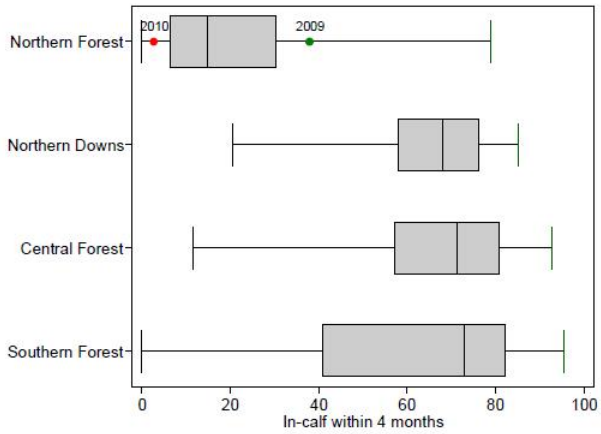

Figure 5. Percentage of cows in-calf within 4 months for each country-type.