

Foreword: Reproductive performance of northern Australia beef herds

The aim of this special edition is to report the findings from the Northern Australian Beef Fertility Project, subsequently branded ‘Cash Cow’. The series of papers is essentially the first accurate situation analysis for commercial cow herd performance in northern Australia. This project was funded by Meat and Livestock Australia, collaborating beef breeding businesses and partner institutions and government departments in Queensland, the Northern Territory and northern Western Australia. It was initiated because of producer concerns about persistent high losses in breeding herds between confirmed pregnancy and weaning, especially first lactation cows. Further, although there had been several excellent studies defining reproductive performance and factors affecting performance of research station herds, there had been no population-based study of commercial breeding herds conducted in northern Australia. There is a series of 10 papers reporting major project findings. Seven of these formed the basis for the PhD awarded to Kieren McCosker in 2016.

Cash Cow was designed to answer two fundamental questions:

1. why do some breeding herds have good reproductive performance, and others significantly poorer performance; and
2. why do some breeding females readily conceive and wean a calf, while others either take significantly longer to conceive or fail to wean a calf.

To address these questions, a 4-year (2007–11) prospective epidemiological study of property-, management group- and animal-level factors affecting the reproductive performance of a selected population of commercial breeding mobs was conducted. Key property selection criteria were that owners/managers were prepared to muster enrolled cattle at least twice a year, once for branding/weaning and then again for pregnancy diagnosis, and would insert National Livestock Identification System (NLIS) tags in all enrolled cattle.

Approximately 56 000 NLIS-tagged cows managed in 165 management groups located on 78 commercial beef cattle properties distributed across the major beef breeding regions of northern Australia were enrolled in Cash Cow, and monitored for three or four consecutive years using a crush-side electronic data capture system. This system was shown to be capable of capturing up to 20 pieces of data (e.g. body condition score, lactation and pregnancy status) on each enrolled heifer or cow at typical processing rates of 60–80 animals per hour. Fetal ageing was used at the time of annual pregnancy diagnosis to enable the month of conception and calving to be estimated, and lactation status at the time of branding or weaning was used to assess calf rearing outcome. Overall, this enabled determination of:

1. if, and how efficiently, cows became pregnant after calving;
2. if pregnant heifers and cows weaned a calf; and
3. whether it was likely pregnant cows had died during the study period.

New measures of reproductive performance were developed: the percentage of lactating cows that became pregnant within 4 months of calving (P4M), percentage fetal and calf loss, and annual percentage of pregnant cows that were subsequently listed as missing (an estimate of cow mortality rate). Exploratory multivariable modelling was used to assess the impact of 85 herd management, nutritional and environmental (including infectious disease) risk factors on each performance measure.

The first paper in this special edition reports the demographics and the nutritional, breeding and herd health management practices used by the beef breeding businesses enrolled in Cash Cow. It critically introduces the four country types that were used to define the broad geographical location and production potential of the grazing on offer to enrolled herds. Further, producers in each country type were asked to provide an estimate of average annual growth of yearling steers if they were to graze the pastures that the Cash Cow heifers and cows would graze. For the Northern Forest, Northern Downs, Central Forest and Southern Forest, the median estimated annual steer growth was 105, 160, 181.5 and 200 kg, respectively, with an overall range of 75–250 kg. This highlights the markedly lower productivity of the Northern Forest, which features poor soil fertility and very harsh environmental conditions.

The second paper describes the measures of reproductive performance used and their application across both controlled- and continuously mated management groups. Importantly this paper describes the measured rather than estimated performance of commercial management groups representing a broad cross-section of north Australian beef breeding businesses. Typical (median value) and potentially achievable (75 percentile) performance by country type provides producers and advisors with commercially accurate reference levels of performance for the first time. The observed performance of cattle in the Northern Forest was typically lower compared with other country types; most strikingly across parities, the percentage of lactating cows that became pregnant within 4 months of calving was less than 19%. It was concluded that 66 calves weaned annually per 100 cows mated is an appropriate target for the Northern Forest and at least 75–80 calves weaned annually per 100 cows mated should be used for other country types.

Descriptive summaries of the management, nutritional, environmental and animal risk factors identified as major determinants of one or more measures of the performance of the Cash

Cow mobs are provided in the third paper of this series. This provides the reader with the essential background data required to understand how each risk factor contributes to observed reproductive performance.

The fourth paper defines the impact of the major factors affecting the probability of lactating cows becoming pregnant within 4 months of calving. Not surprisingly P4M for cows in the Northern Forest was 41–49% lower when compared with the other country types. Estimated month of calving also had a large impact with the P4M of cattle calving in July–September being 49% lower than those calving in December–January across all country types. Low wet season pasture protein and phosphorous, and high mob seroprevalence of bovine viral diarrhoea virus (BVDV) were predicted to lower P4M by 13%, 20% and 23%, respectively. Also, as expected, the body condition score of cattle at the time of pregnancy diagnosis (typically mid-dry season, 4–5 months prior to calving) affected P4M but the magnitude of the impact was influenced by country type.

The major factors affecting the probability of cows being non-pregnant after 12 months are described in the fifth paper. Some 27%, 37% and 37% of enrolled properties mated females for periods of 2–3 months, 4–7 months and >7 months respectively. Previous reproductive status (pregnant, not pregnant), parity, timing of calving and body condition score at weaning, grazing of low digestibility pasture in the dry season and phosphorous-inadequate pastures in the wet season all affected likelihood of cows being non-pregnant.

In the sixth and seventh papers in the series the major factors affecting the probability of pregnant cows experiencing fetal or calf loss (calf wastage), and pregnant cows being subsequently listed as missing (an estimate of cow mortality) are described. Interactions between environmental factors (temperature–humidity index >79 during month of calving in all country types except Northern Forest), nutritional factors (low dry season body condition score or Northern Forest country type, and grazing of phosphorous-inadequate pastures in the wet season) and management factors (mustering first lactation cows within 2 months of calving) were strongly associated with calf wastage. In addition, failure to rear a calf the previous year, tall cows, low pasture protein during the dry season, serological evidence of widespread recent infection with BVDV and *Campylobacter* subsp. *fetus venerealis*, and perceived wild dog predation were all associated with increased calf wastage. High rates of missingness of pregnant cows were associated with not having follow-up rainfall more than 30 days after the first wet season storms, low pasture biomass in the early dry season, an interaction between low dry season pasture biomass and suboptimal body condition score mid-dry season, and calving between April and September.

In the eighth paper in this series a subset of Cash Cow properties ($n = 31$) were used to examine how annual rainfall and method of wild dog control affected the probability of pregnant cows experiencing fetal and calf loss. The percentage of fetal and calf loss was predicted to be higher in dry and very wet years, compared with moderate-rainfall years. Taking into account annual rainfall, the frequency of lethal baiting to control wild dogs did not affect losses in mature cows, and increasing the frequency of baiting did not consistently reduce losses in first lactation cows.

It was concluded that there is limited evidence that lethal baiting significantly reduces fetal and calf loss.

The Cash Cow project also provided an excellent opportunity to examine the impact of reproductive performance on liveweight production, a primary measure of performance of beef breeding businesses. In paper nine, three practical measures of liveweight production per cow, and production by country type, are defined. Weaner production per cow (average weaning weight multiplied by lactation rate for a mob) a readily measured parameter, was shown to be correlated with estimated annual growth of yearling steers in the same environment, providing producers with a useful guide to the liveweight production they should expect from their breeding mobs. To investigate, in particular, cow-level traits affecting liveweight production, the Beef CRC database was used because the dam of each calf had been determined. Liveweight production averaged 103–143 kg higher for cows that weaned a calf than those that lost a calf. Calf weaning weight was 25 kg higher in mature cows than in first- and second-lactation cows.

In the final paper in the series, the findings described in the ninth paper were applied to better define the structure, performance and live weight production of the Australian cattle herd. The key difference to accepted estimates of herd size is that survey data was not used, but rather key national herd output data (number and weight of cattle slaughtered and exported) were used to calculate national cattle numbers and performance and production indices for the period 1976–2018. The calculated numbers of beef cattle exceeded published survey data by over 50% with the national herd varying between 30–40 M since 1985. Despite relatively consistent herd size, productivity of the cattle herd increased from ~2.5 to 4.5 Mt of liveweight annually over 35 years. Half of this change was due to reductions in mortality, with a quarter each of the change due to increased reproductive output and to steer growth. The findings from this unique study clearly identify what the national- and producer-level priorities should be to ensure a sustainable and profitable industry.

This large project has demonstrated that the reproductive performance and liveweight production of extensively managed breeding herds across northern Australia can be accurately monitored, and the major herd management, nutritional environmental and animal factors affecting performance and production identified, and their impacts quantified. A significant proportion of the variation between cattle and management groups could be explained by known factors, primarily nutritional and herd management factors. The research described in this series highlights the critical importance of strategic monitoring of reproductive performance and liveweight production, being aware of the major factors affecting performance and production, and implementing effective interventions to control these.

I would like to formally acknowledge the wonderful co-operation and input from the beef cattle business operators and project staff involved in this project, for without it none of these papers would ever have been published.

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