



# final report

Project code: B.NBP.0761

Prepared by: Matt Wolcott, David Johnston, Rob Banks and Yunadan Zhang  
Animal Genetics and Breeding Unit

Date published: 30th November 2015

PUBLISHED BY  
Meat and Livestock Australia Limited  
Locked Bag 991  
NORTH SYDNEY NSW 2059

## **New genetic predictors for improving cow reproduction**

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

This publication is published by Meat & Livestock Australia Limited ABN 39 081 678 364 (MLA). Care is taken to ensure the accuracy of the information contained in this publication. However MLA cannot accept responsibility for the accuracy or completeness of the information or opinions contained in the publication. You should make your own enquiries before making decisions concerning your interests. Reproduction in whole or in part of this publication is prohibited without prior written consent of MLA.

## **Abstract**

Reproductive performance is a key driver of productivity and profitability for Australia's northern beef industry. This project aimed to build on the research undertaken as part of the Cooperative Research Centre for Beef genetic Technologies (Beef CRC) to improve our understanding of the consequences for female growth and body composition of selection to improve reproductive performance and to identify new opportunities, including genomic technologies, to apply indirect selection to female and correlated male reproduction traits. Results showed that superior (earlier) age at puberty, lactation anoestrous interval and lifetime reproductive performance were genetically associated with lower cow body condition and higher likelihood of cows falling to an "at risk" body condition. A key recommendation of this project is that a measure of body condition in lactating cows be included in the BREEDPLAN evaluation for tropical breeds to allow breeders to monitor and manage this trait while selecting to improve reproductive performance. The project also identified new opportunities to exploit genomics in the evaluation for female reproductive performance and correlated male fertility traits, as well as in the evaluation of cow weight and body condition. Opportunities for ongoing research have been identified which if pursued will build on the new understandings developed in this project.

## Executive Summary

Reproductive performance is a key driver of productivity and profitability for Australia's northern beef industry. Research reported as outcomes of the Co-operative Research Centre for Beef Genetic Technologies (Beef CRC) showed that intensive measurement of female and male reproduction presented opportunities to significantly improve the rates of genetic improvement both Brahman and Tropical Composite genotypes. As part of that research, extensive records describing growth and body composition of mature females were also collected. Following from that work, a key aim of the current project was to examine the genetic basis for variation in cow weight, height and body composition, and investigate any possible adverse correlated responses associated with selection to improve female reproductive performance. This project analysed previously collected Beef CRC data to conduct new research which also aimed to improve our understanding of genetic and non-genetic factors associated with female and male reproduction, and to identify new opportunities to exploit more easily measured traits, including genomic tests, as indicators of reproductive performance.

Key findings and recommendations from the project were that:

- Genetic differences exist between sires for the pattern of development of weight, height and body composition in their daughters as they progress to maturity and throughout their reproductive lives. These differences could be exploited through selection to change weight and body composition characteristics of the mature, lactating cow herd.
- Measures of fatness, eye muscle area, body condition score and to a lesser extent liveweight in non-lactating heifers are not genetically the same traits as those measured in lactating cows (particularly in Brahmans). Measures of these traits in lactating cows will therefore be required if they are to be changed by selection.
- There are genetic differences in the capacity of cows to maintain body condition above a defined critical level throughout their lifetime, with a proportion unable to do so at higher reproductive rates. As selection pressure is applied to improve female reproduction it is important that correlated changes in cow condition are controlled to avoid increases in the incidence of critically low cow body condition. It is therefore recommended that cow body condition score, measured at the beginning of their second and subsequent annual matings, be included as a new trait in the BREEDPLAN evaluation for tropical breeds.
- The genetic relationships of cow hip height with female reproductive performance change with age, and tend to be stronger for Tropical Composites than for Brahmans. It is recommended that hip height be included as a new trait in the BREEDPLAN evaluation for tropical breeds to give breeders an opportunity to apply selection pressure to the trait, both individually and as a component of a selection index.
- The project also showed that genomic accuracies estimated for the range of cow weight and body condition traits would allow effective genomic selection for these late in life traits, and this opportunity should be exploited in the BREEDPLAN evaluation system.

- Genomic analyses of teat size and sperm cell abnormalities detected large numbers of statistically significant SNPs but no single SNP of large effect. It is unlikely, therefore, that a simple useful diagnostic test, based on one or a few QTL or SNPs, could be developed. Conventional genomic selection, however, was shown to present opportunities to improve these traits by selection.
- Preputial eversion is a heritable trait and the project has established that it can be measured over a wider age range than previously reported. The trait is a useful indirect measure of key aspects of female reproductive performance, and it is recommended that it be considered as an additional trait in the BREEDPLAN evaluation for tropical beef breeds.
- For both Brahman and Tropical Composites, calves born at low birth weight (<28kg) are at significantly greater risk of mortality than heavier calves. The analyses here demonstrated a genetic basis for the proportion of calves born at critically low birth weights, though the biological mechanisms underlying this are still not well understood.
- Over almost 12,000 mating events, there was an estimated 6% prenatal loss in both Brahman and Tropical Composites. These occurred mainly in the 1<sup>st</sup> trimester of pregnancy and at similar rates in Brahman and Tropical Composites. There was little evidence of a genetic basis for these losses and no major contributing non-genetic factors could be identified.
- The estimation of breed composition based on genomic information in a stabilised composite population and the relationship of composition with selected performance traits was evaluated. The project demonstrated the ability to accurately describe breed composition in a subset of composites evaluated in the Beef CRC. It also showed that differences in breed composition, based on genomic information, are related to performance for key female (reproductive performance) and steer (carcass and meat quality) traits among animals of this stabilised composite 'breed'. This will help inform the development of 'single step' evaluations in BREEDPLAN for instances where animals of stabilised but mixed breed composition are included in the analysis (assuming all founder breeds are known and representative genotypes are available for them).

This project has significantly improved our understanding of the complex genetic associations of economically important male and female reproduction traits with cow growth and body condition in tropical beef genotypes in northern Australia, and developed new opportunities for genomics to contribute to the genetic evaluation of these. On the basis of these results recommendations to improve the genetic evaluation for tropical breeds can be made, some of which have already been implemented. Opportunities for ongoing research have also been identified, which can continue to build on the new understanding developed from this project.