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Foreword

The aim of this special edition is to report results from the Maternal Productivity project of the Cooperative Research Centre for Beef Genetic Technologies (Beef CRC). The project was conducted from 2005–2012 with final data analysis undertaken after completion of the CRC. The project was primarily funded by Meat and Livestock Australia through the Beef CRC.

The project was initiated following concerns from beef cattle breeders that while there had been significant genetic improvement in feedlot and abattoir performance of cattle, it may have led to a decline in maternal productivity, especially under variable environmental conditions. The heart of the concern was that heifers and cows may have become too lean, and in poorer years this may lead to low pregnancy rates. The concern was addressed using a dual approach of first, a designed experiment on research stations, and second, collecting additional measurements of cow body composition in performance-recording seedstock beef cattle herds.

The designed experiment examined two divergent selection lines of cattle established on two research stations, being Struan near Naracoorte in SA and Vasse near Busselton in WA. The divergent selection lines chosen were for Fat and for Residual Feed Intake (RFI, a measure of feed efficiency). The Fat lines were established with heifers purchased from cattle studs and selected on the basis of Rib Fat depth estimated breeding value (EBV) as this trait was related to the strongest concern amongst cattle breeders. Heifers for the RFI lines came from already established divergent selection lines and were chosen because the direct response to selection was also accompanied by change in subcutaneous fat. In the Australian cattle industry, an EBV for net feed intake (NFI, which is an alternative name for RFI) is available, but industry concern that the reduction in fatness in Low-RFI (more efficient) cattle leading to compromises in maternal productivity was holding back industry use of the EBV and was related to industry concern over appropriate cow fatness. The experiment was not designed to directly compare the Fat lines to the RFI lines as the origin of the lines was confounded.

The special edition starts with a paper by Brad Walmsley and colleagues who review the literature on maternal productivity for temperate beef cattle. It is fitting that Brad also wrote the final paper, which takes information from within this special edition and proposes a strategy for future modelling approaches for improvement in maternal productivity and eliciting practice change.

The second paper provides the motivation behind the project and the design of the research station and on-farm work. A key achievement of the work is the collection of pasture feed intake on 64 groups of cows at weekly intervals for 3½ years run under divergent nutritional regimes (either High or Low that differed in feed on offer by 20% applied from the completion of joining as yearling heifers). This intense study was both expensive and informative, and involved a large team of scientists and farm staff. The TechnoGrazing™ system at Struan proved to be superb for this work. However, there were still limitations in that treatment groups had to be combined during the period of autumn supplementary feeding at Struan and there were only two replicates at Vasse (16 groups). An additional limitation of the work was that the experiment was designed to ensure that both High and Low (Fat or RFI) lines were treated the same. Treating the lines the same meant that if during periods of low pasture availability when an animal in a treatment group declined in condition to a score of less than 2 (on a scale out of 5), then this triggered supplementary feeding of animals in both High and Low treatment groups, which would not be usual commercial practice. The effect of this is well described by Jeisane Accioly in paper 4 of the research herd series.

There is a series of 7 papers reporting results from the research station experiment. Fiona Jones (paper 1) reported that genetically fatter heifers (higher Rib Fat EBV) had higher conception rates, especially if considered under a shorter joining period. The EBV that was most closely related to pregnancy rates was the Days-to-Calving EBV and that the effect was greater in heifers. The biggest effect expected in the experiment was for the combination of genetically Low-Fat, Low-Nutrition and rebreeding during their first lactation. Michael Laurence (2) reported that the Low-Fat line did not 'crash'. While the Low-Fat line had slightly lower pregnancy rates and were leaner, the effects were small. Some will conclude that this means that the original industry issue is smaller than originally proposed, while others will be critical that the cows were not managed under the conditions observed in commercial production. Katrina Copping (3) then reported results in mature cows that showed negligible effects on reproductive performance, but Low-Fat cows continued to be leaner than High-Fat cows. The Low-RFI were leaner than High-RFI cows and in many ways mirrored the differences between the Fat lines.

Michelle Hebart (5) reported the results on efficiency or productivity using a range of measures. Due to the higher reproductive rates in younger cattle, the High-Fat line was more efficient than the Low-Fat line. Also, as expected, the Low-RFI line ate less and had greater efficiency (maternal productivity) than the High-RFI selection line, demonstrating that divergent selection for post-weaning RFI will lead to cows that differ in RFI, although the differences were greatest during spring when pasture feed cost is lowest. Mick Deland (6) purchased the steers from this experiment and grew them out on pasture. He reports that greater numbers of steers from Low-Fat cows failed to reach minimum carcass fat depth specifications than those from High-Fat cows. This was not a problem for feedlot finished steers. Lucy Anderton (7) modelled herds based on the data and found that due to Low-Fat and Low-RFI cows being genetically bigger (taller and heavier) than their High-line counterparts, and that the High lines were fed more than necessary, both Low lines (Fat and RFI) had higher gross margins when feed cost was calculated either as a constant feed cost or as a constant farm size. Given that non-pregnant or

lactating heifers and cows still have significant sale value, the lower reproductive rates were less of a penalty than expected.

Stephen Lee interviewed leading seedstock producers and concluded that there are quite different attitudes or strategies to running cows, even within the same district and similar topography (paper 1 in the seedstock herd series). His findings guided the analysis of both the designed experiment and seedstock herd data and are reflected in most of the papers herein. Paper 2 reports relationships between EBVs and cow body composition and quantifies many of the relationships that breeders observe. Paper 5 then examined whether genetic change in the stud herds over a 9-year period reflected what they had said about maternal productivity. Rib Fat EBV accounted for the largest difference in selection direction between herds.

Joanne De Faveri (paper 3) and Kath Donoghue (4) reported results from analysing ultrasound scans of Angus and Hereford cows at pre-calving and weaning of their first and second calf. They found that measures of cow body composition are highly heritable and highly genetically correlated across ages. The high genetic correlations mean that genetically fatter cows at one point in time will also be genetically fatter at a subsequent time, i.e. there is little genetic variation in change in fat or muscle over time despite there being significant genetic variation in absolute fat and muscle. A partial exception to this finding is that the genetic correlations between times as heifers (pre-calving) and as cows (weaning of first calf onwards) were strong, but those between pre-calving and weaning of first calf were not as strong.

Lastly, there are three papers that provide valuable additional insights to the issues of initial concern, but which were not part of the main Maternal Productivity project. Robert Herd reported results on long-fed steers from the RFI lines, adding information to the steer paper of Mick Deland and supporting the finding that Low-RFI line steers are heavier, more feed-efficient and have less subcutaneous fat. However, there was negligible difference in intramuscular fat suggesting that selection for Low-RFI may be leading to improved fat distribution.

David Lines conducted a pen trial of High- and Low-RFI heifers at different feeding levels and demonstrated there was only a difference in RFI when animals were fed close to *ad-libitum* levels. He demonstrated that the response to selection for Low-RFI was to reduce appetite rather than reduce basal metabolic rate. This finding supported results by Michelle Hebart (paper 5) for related RFI cows on pasture at different times of the year. The implication is that the times of the year when there are the biggest differences in feed intake are also those times when feed is plentiful and cheap.

While not reported explicitly, in many of the analyses of the designed experiment the relationship with muscle (EMA EBV) was tested and there were no negative relationships with cow reproduction, maintenance of body composition or calf growth. Some key results are reported from separate research conducted in NSW on the NSW Department of Primary Industries Angus muscling selection herd. This paper by Linda Cafe is a valuable inclusion to the special edition as it provides evidence that selection for increased visual muscling (muscle score) in Angus cows did not negatively impact on maternal productivity. This research supports breeders of British breed herds selecting for increased muscling as part of their breeding objective, as it leads to increased carcass yield with no apparent cost to maternal traits.

While it has been stated in the conclusions of many of the papers herein, it is important to conclude by reminding breeders of beef cattle to select for a balance in traits, ideally through a balanced breeding objective, and to record traits that affect profit. I commend to you this large body of work and feel privileged to have led such a dedicated team of people.

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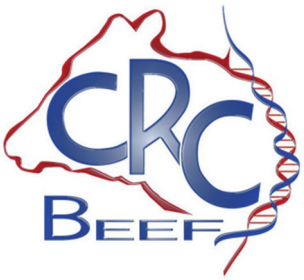
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