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HAS THE BEEF GENETIC IMPROVEMENT PIPELINE BEEN EFFECTIVE?

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SUMMARY

Genetic improvement achieved by the Angus breed was examined to demonstrate the effectiveness of the beef genetic delivery pipeline in Australia. This pipeline has resulted in superior rates of genetic improvement for key economic traits relative to those achieved for the Angus breed in other countries. The accumulated present value of returns in the temperate Australian beef industry resulting from the genetic improvement achieved in Angus to 2014 was estimated to be $1.621 billion, projected to increase to $2.514 billion in 2024.

INTRODUCTION

There has been debate in recent times regarding the effectiveness of the existing pipeline for the delivery of genetic improvement to the Australia beef industry (e.g. Woolaston, 2014). The current pipeline, described by Parnell (2007), involves partnerships between cattle breeders, breed associations, commercialisers, and RD&E providers. Genetic evaluation using BREEDPLAN (Graser *et al* 2005) has been a central element of the pipeline over the past 30 years. Hammond (2006) reflected on the past success of collaborative partnership arrangements between Meat and Livestock Australia (MLA), the Animal Genetics and Breeding Unit (AGBU), the Agricultural Business Research Institute (ABRI), state departments of agriculture, various breed associations and pioneering breeders in the design, development and implementation of BREEDPLAN and its important enhancement, BreedObject (Barwick and Henzell 2005).

This paper examines genetic improvement in the Angus breed as an example of what has been achieved through the existing delivery pipeline. Members of Angus Australia are responsible for over 40% of animals registered in the Australian beef seedstock sector, as compiled by the Australian Registered Cattle Breeders Association (ARCBA). They account for 40-60% of the performance records collected in the sector. The Angus database contains over 1.75 million animals, of which 1.2 million animals have performance data contributing to a total of over 6.7 million records. Angus Australia makes considerable annual investment in breed development initiatives including provision of recording and genetic evaluation services to members, pedigree and DNA quality assurance, and the conduct of applied research. An important component of Angus Australia’s business is its partnerships with MLA, AGBU, ABRI and other service providers in the provision genetic evaluation services for its members.

MATERIALS AND METHODS

In order to compare rates of genetic improvement in the Australia Angus population with those achieved in other countries the published trends in Estimated Breeding Values (EBVs) and/or Expected Progeny Differences (EPDs) for a sample of comparable traits were scaled to standard units. The Australian, New Zealand and UK EBV trends were scaled according to the respective additive genetic variances assumed in the Angus BREEDPLAN analysis. The USA and Canadian EPD trends were scaled according to the additive genetic variances used to “import” these EPDs into the Angus BREEDPLAN analysis (B.Tier, pers. comm.). These trend comparisons can only be considered approximate due to differences in trait definitions across countries and differences in the analysis models used in each respective analysis. For example, a full multi-trait model is used to calculate EBVs in BREEDPLAN, whilst some traits (e.g. birth weight) are only included in a single-trait analysis model to calculate US and Canadian EPDs.

A simple model was developed to quantify the approximate economic gains achieved in the temperate Australian beef industry resulting from genetic improvement by Angus seedstock breeders since the commencement of Angus BREEDPLAN genetic evaluation in the mid-1980s. The model accounted for genetic improvement in the registered Angus seedstock population, as measured by the trend in the average Angus Breeding Index value (Angus Australia, 2015). For simplicity, the model ignored any benefits accrued in the sub-tropical northern beef industry where Angus genetics has also had significant penetration in recent years.

Since no accurate statistics are available on the breed composition in the Australian beef herd it was assumed that the proportion of Angus animals represented in the temperate commercial beef population was equivalent to the proportion of Angus cattle in the seedstock sector relative to the total number of breeding females registered across all temperate breeds, as published annually by ARCBA. These statistics show that the proportion of Angus cattle in the seedstock sector increased from about 10% in the early 1980s to 47% in 2014. The model assumed that 75% of the industry sources their bull replacements from recorded seedstock herds (Tier 1 commercial herds), with a 5 year lag in genetic improvement (approximately 1 generation). Further, it was assumed that the remaining 25% of commercial herds (Tier 2 commercial herds) had a 10 year lag (approximately 2 generations) in genetic improvement relative to the seedstock sector.

Statistics on the numbers of breeding females mated each year in the temperate Australian beef herd were estimated from industry data provided by MLA (B. Thomas, pers. com.), with 50% of these cows assumed to be run in temperate regions where Angus bulls are commonly used. A discount rate of 7% was used to adjust returns over time to present value. Predicted returns for the subsequent 10 years beyond 2014 assumed no change in the size of the commercial cattle population and no further increase in the proportion of Angus cattle in the temperate beef herd.

RESULTS AND DISCUSSION

Figure 1 shows that the average rates of genetic improvement in key economic traits achieved in the Angus bred in Australia over the past two decades generally exceeds those achieved in other major Angus populations globally. Unfortunately, it is not possible to compare progress in profitability indexes used in different countries due to vastly different index assumptions used. However, it is expected that comparative gains in overall profitability will be directly related to gains achieved in key economic traits as shown.

Figure 2 shows the actual trends in average Angus Breeding Index values for registered Angus herds to 2014, and the predicted lagged trends in Tier 1 and Tier 2 commercial herds in temperate Australia. Also shown are the discounted returns over time from the modelled genetic trends in temperate commercial herds. These results show that the long-term genetic improvement in Angus seedstock herds, coupled with increased market share of Angus, has generated significant economic benefits for the commercial beef industry in Australia. The accumulated present value of returns resulting from the genetic improvement to 2014 was estimated to be $1.62 billion, projected to increase to $2.51 billion in 2024. Considering the market share of Angus at the time, these results are consistent with the magnitude of cumulative gross returns resulting from selection and crossbreeding in southern Australia to 2001, estimated by Farquarson *et al.* (2003).

Breeders typically have a myriad of breeding objectives, based on their interpretation of market signals and factors influencing profitability. Consequently, it is inaccurate to assume that all participants of the value chain agree with the implied breeding objectives underpinning the trends in index values typically used to monitor genetic progress in the industry. Angus breeders who have focused on profitability indexes have made excellent genetic progress with respect to these indexes (Johnston 2007). Sub-potential gains achieved in some herds or breeds are likely not to be a function of the delivery pipeline, but rather the lack of motivation for genetic change by some breeders and/or differing breeding objectives not adequately described by existing measures.

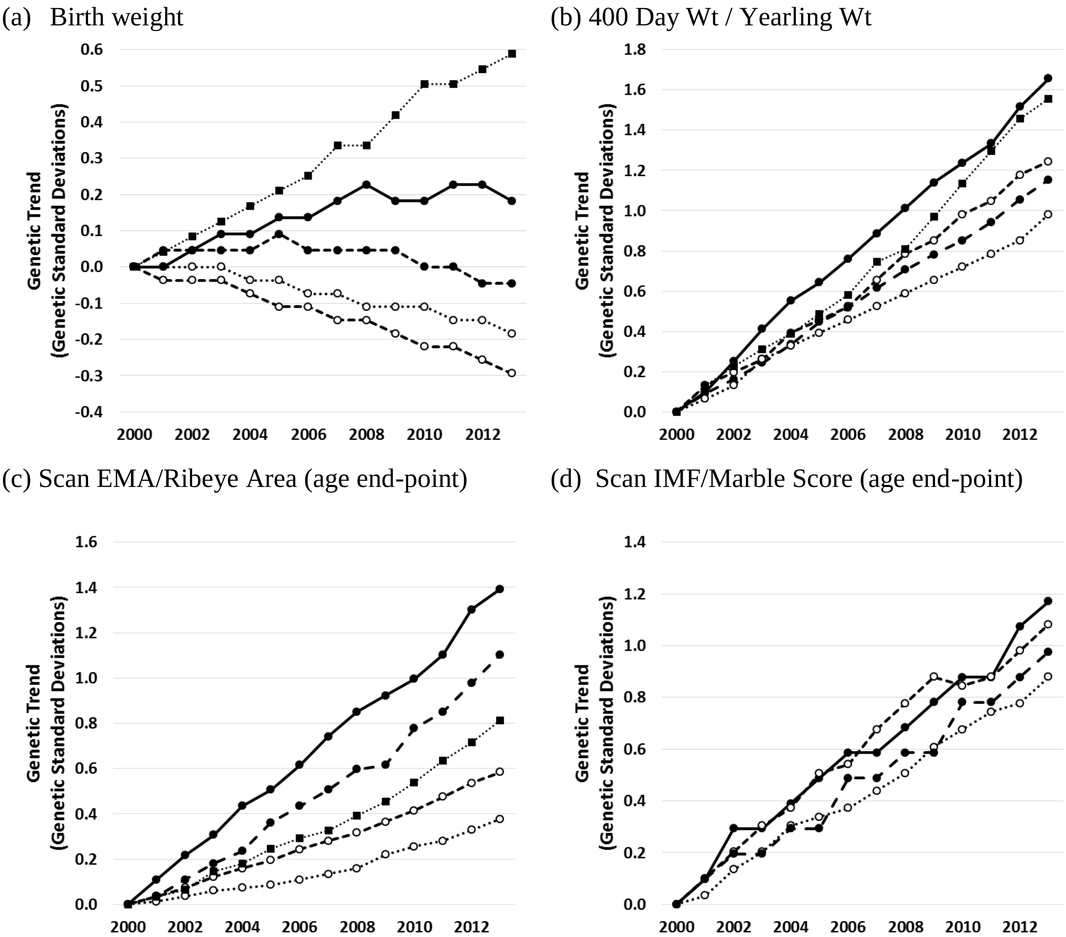

Figure 1. Standardised genetic trends for (a) Birth weight; (b) 400 Day Wt/Yearling Wt; (c) Scan EMA/Ribeye Area; and (d) Scan IMF/Marble Score in different Angus populations. Legend: —●— Australia - -○- - USA – ● New Zealand ···○··· Canada ···■··· UK

Whilst rates of genetic gain in Australian Angus have been equal to or superior to comparable beef populations, they are still well below theoretical potential gains (Johnston 2007), the rates of improvement shown in various research populations (e.g. Parnell *et al.* 1997) or those achieved in segments of the Australian sheep industry (e.g. Swan *et al.* 2009). It is suggested that the significant scope for enhanced rates of genetic improvement in the beef industry can be adequately realised within the current pipeline structure. There is a lack of evidence to indicate that re-structuring of the pipeline will have any significant impact on future rates of progress.

There is no doubt that elements of the existing beef genetic delivery pipeline can be improved to enhance rate of technology development and to address constraints to delivery of more efficient and effective recording, genetic evaluation and extension services. As suggested by Parnell (2007), there is a need for all participants in the pipeline to engage in more effective value chain partnerships to provide improved market signals, incentives, motivation and associated rewards from the application of genetics technology.

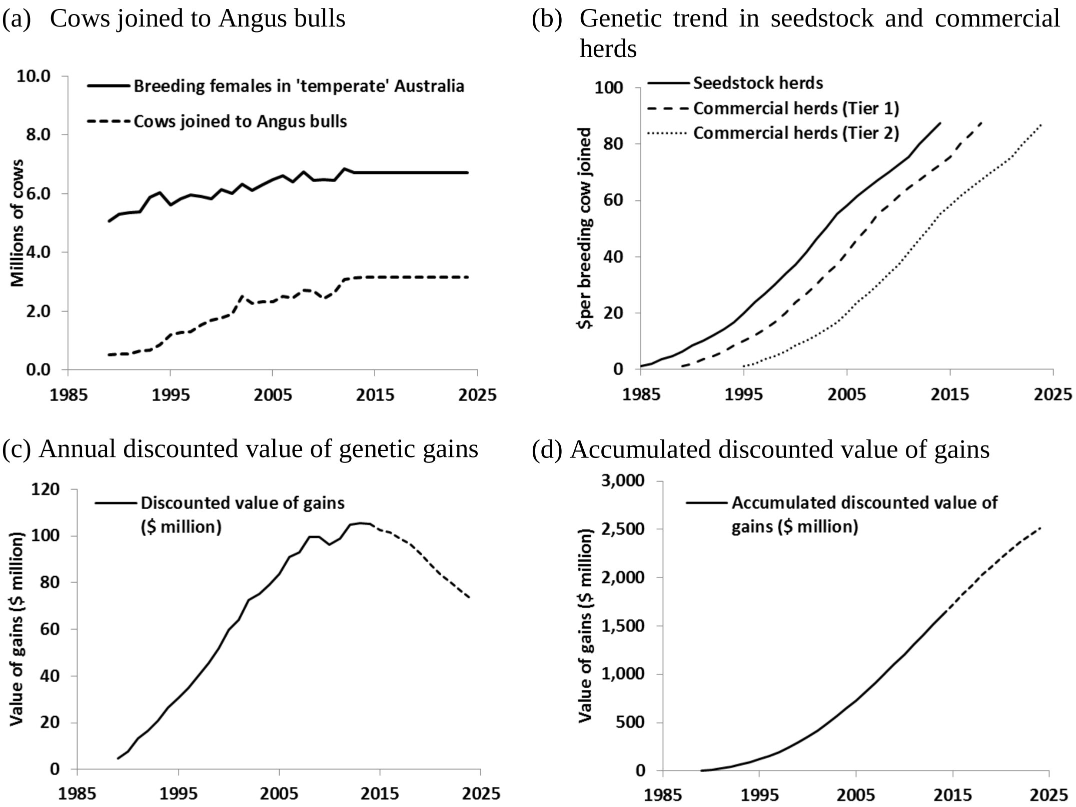

Figure 2. Modelling industry economic benefits resulting from genetic improvement in the Australian Angus population.

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