AUSTRALIAN BEEF CATTLE BREEDING OBJECTIVES

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SUMMARY

BreedObject is the software used to formalise breeding objectives and create the selection indexes produced by BREEDPLAN. The BreedObject breeding objectives and selection indexes allow cattle producers to identify the most profitable cattle genetics for the beef production system modelled by each selection index. Since the release of the latest version (6.2) of the BreedObject software, eight Australian beef cattle breed organisations have implemented 29 new or revised selection indexes. This paper discusses the process by which the selection indexes were developed in conjunction with the relevant breed societies, summarises the EBV emphases applied in these new selection indexes, and discusses the breeder feedback and implications of the selection indexes in the greater industry.

INTRODUCTION

Selection indexes provide an overall estimate of an animal's genetic value for profit for a specified production system. Selection indexes are calculated by placing weightings on individual traits, with these weightings derived from the economic importance of the trait. As such, selection indexes reflect both the short-term profit generated by a bull through the sale of his progeny and the longer-term profit generated by his daughters if they are retained in the herd. The costs of production, including feed, are also accounted for. The selection indexes published by BREEDPLAN are calculated using BreedObject software (www.breedobject.com) and are reported in units of net profitability per cow mated ($) for the production system/market scenario that they represent.

MATERIALS AND METHODS

The development process for constructing a BreedObject selection index starts with individual breed organisations determining which production systems are the most relevant for their membership. This decision is influenced by the types of production systems that each breed organisation's genetics are currently used in or are expected to be used in the future. Once ready, each selection index is only made available for animals recorded on the relevant breed organisation's database. This allows the selection index definitions and inputs (including genetic parameters) to be specific to each breed organisation's recorded population.

Once the desired production systems were identified, a detailed description of the input costs and value generation of the commercial herd/production system was required for the BreedObject software. This process involved approximately 180 questions with the actual number varying between the selection indexes as the presence of some questions were reliant on prior answers. These questions included details of typical levels of production, herd population structure, prices received, costs of production etc in commercial herds.

Once the target production system was described, the BreedObject software assessed what emphasis needed to be applied to each trait to achieve profitability increases in the production system

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and market end point for which each selection index was designed. This step included evaluating the selection response expected from direct selection on the individual EBVs and the correlated responses expected from selection on related EBVs. Nonlinear effects (e.g. penalties for both under and over fat specifications) are also accounted for. Details of each selection index are available via the Help Centre on the BREEDPLAN website (https://breedplan.une.edu.au/help-centre/).

This paper summarised the EBV emphases applied in each of the new selection indexes implemented since 2018 using version 6.2 of the BreedObject software for Australian breed organisations. The selection indexes were grouped according to whether they were designed for replacement heifers to be retained in the herd (self-replacing) or not (terminal).

RESULTS AND DISCUSSION

A total of 29 new or updated selection indexes using version 6.2 of the BreedObject software have been made available since 2018 via the Australasian Charolais, Belmont Red, Brahman, Hereford, Performance Herds Australia, Southern Limousin, Trans-Tasman Angus, and Wagyu BREEDPLAN analyses. Of these selection indexes, 21 were self-replacing and 8 were terminal selection indexes (Table 1). Beyond the self-replacing/terminal differentiation, there was considerable variation in the target markets and production environments represented by the selection indexes. The target slaughter ages varied from 15 to 32 months, which in turn contributed to the corresponding variation in the target slaughter weights (Table 1) and emphasis on carcase EBVs. Part of this variation was due to the wide variety of production environments present across Australia from the tropical conditions in the north to the temperate regions in the south of the country. In addition, most breed organisations also had international members (predominantly from New Zealand) to consider at some level when developing their selection indexes. The presence of genotype by environment interactions in the resulting breeding objectives is consistent with the findings of Walmsley & Barwick (2018).

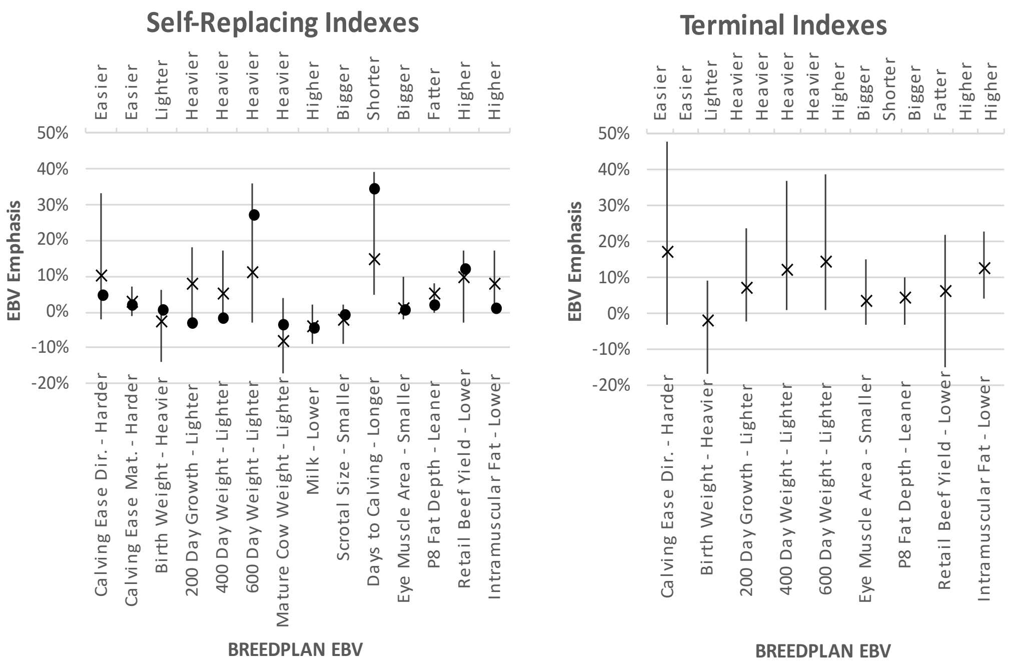
Table 1. Summary of the Selection Indexes and their corresponding market endpoints that are analysed in this paper

	Self-Replacing	Terminal
Number of Selection Indexes Analysed	21	8
Number of Breed Associations	8	6
Target Steer Slaughter Age Range (months)	15 to 32	12 to 29
Target Heifer Slaughter Age Range (months)	15 to 29	12 to 27
Target Steer Carcase Weight Range (kg)	250 to 460	205 to 360
Target Heifer Carcase Weight Range (kg)	230 to 410	190 to 300

Figures 1 and 2 show the range of, and the average EBV emphasis in the self-replacing and terminal selection indexes. With no daughters retained for future breeding, the maternal EBVs received no emphasis in the terminal selection indexes, thus allowing the emphasis applied to the calving, growth and carcase EBVs to be greater than in the self-replacing selection indexes. It should be noted that only one terminal selection index for a *Bos indicus* breed type was developed and implemented in the timeframe of this study. Therefore, some of the observed differences between the self-replacing and terminal indexes are likely to be due to the resulting variation between the breed types and the environments where they are typically (but not exclusively) run in Australia (*Bos indicus* breed types in the northern part of the country and *Bos taurus* in the south).

Within the self-replacing selection indexes, there were noticeable differences between the *Bos indicus* and *taurus* breed types. The selection indexes developed for the *Bos taurus* breed types typically had a higher emphasis on calving ease, earlier growth, and less emphasis on fertility than their *Bos indicus* counterparts. The higher emphasis on fertility (the Days to Calving EBV) in *Bos indicus* is to address the lower levels of fertility typically observed in Northern Australia (McCosker *et al.* 2010). The Calving Ease EBV emphasis was one of the more variable due to variation in the age of heifers at first calving, the existing levels of calving ease within each breed, and/or the breed with which the bulls were mated to. Additionally, in the breeds that run the majority of their cattle in Northern Australia, there was a desire to maintain or raise birthweights to improve calf vigour and post birth survival.

Regarding the emphasis applied to the three growth EBVs, the majority of the emphasis was applied to the weight EBV that matched the target slaughter age. Therefore, the other, non-target, growth EBVs can have a low or even negative emphasis, particularly if they occur after the target slaughter age. It should be noted that the expected selection response of the Growth EBVs with low or negative emphasis would still typically be positive due to the high genetic correlations between these traits. The Wagyu and any production system involving *Bos indicus* breed type genetics (including *Bos taurus* bulls over *Bos indicus* or *Bos indicus* cross cows) had target slaughter ages greater than 2 years of age, while the *Bos taurus x Bos taurus* selection indexes all targeted slaughter at 2 years or less.



Figures 1 and 2. Range (line) and average (• for *Bos indicus,* × *for Bos taurus* breed types) of the EBV emphasis in 29 Australian Self-Replacing and Terminal beef cattle selection indexes

As part of the selection index development process, breeder input was sought and there were some examples where breeder expectation did not match the emphasis applied by the BreedObject software. There was considerable variation between breeders in their attitude towards the emphasis applied to calving ease, mature cow weight and the carcase traits in the selection indexes. As a consequence, a number of breeds implemented multiple selection indexes where one or more allowed mature cow weight to increase, and the other(s) held or reduced it. Further feedback on

Mature Cow Weight and Days to Calving, centred around the importance of these EBVs to the selection indexes and their relatively low levels of recording (Gudex & Millen 2019). This feedback places emphasis on the need for further extension efforts to promote the recording of these traits. For Days to Calving, this concern was compounded in the four breeds where this EBV was not reported and its emphasis in the selection index is applied through correlated traits. The Milk EBV typically received a low or negative emphasis in the selection indexes which caused concern for some breeders who assumed that increasing the weaning weight of the progeny was always desirable without considering the whole picture (e.g. the effect on cow BCS and her subsequent fertility and health). This assumption by breeders does not completely align with the standard BREEDPLAN advice which advocates selecting for a Milk EBV level appropriate for the environment where the cows are to be run (BREEDPLAN 2023). Environmental impacts were also discussed by some breed organisations, though none chose to add additional emphasis beyond the concept that animals with better production system efficiency will be better for the environment (and profitability).

CONCLUSION

Production systems vary between breeders and breeds, and therefore the corresponding trait emphasis in the selection indexes presented in this paper was variable. While this study summarised the breeding objectives, it is important to acknowledge that other sources of information should and will be used in most animal selection decisions. Therefore, deviations from the breeding objectives described here will be expected in the commercial and seedstock herds that utilise these selection indexes. That said, the results presented here will have practical implications for which traits should have their performance recording and extension messaging prioritised. The paper and methodology will also provide a valuable resource for benchmarking any new selection indexes that are developed or revised for BREEDPLAN.

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