EXTENDED COW LIVEWEIGHT MODELLING FOR BEEF CATTLE BREEDING OBJECTIVES

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SUMMARY

An extended procedure is described for modelling cow liveweight change over the production year for valuing cow liveweight in breeding objectives. The pattern of change, before and after trait change, is able to be approximated from breeder-described variables for any production system. Examination of seven datasets showed cow liveweight changes systematically over age in many herds and breeds. Analyses showed liveweight loss from pre-calving to mating and cow liveweight at mating both change in proportion to the liveweight of the cow pre-calving. Differences in cow liveweight pre-calving are thus larger than are the differences at mating, which affects feed costs in valuing cow liveweight at mating. Adoption of the procedure will increase the precision with which feed cost is associated with cow liveweight in beef cattle breeding objectives.

INTRODUCTION

The breeding female's liveweight is an important breeding objective trait because it affects, especially, the feed needed to maintain the herd or flock. The increase in feed requirement with increasing breeding female liveweight has to be assessed over all parts of the year where feed has a cost. In the BreedObject system for deriving breeding objectives and indexes for beef cattle, cow liveweight in the breeding objective usually has a negative economic value (Barwick and Henzell 2005). The value for cow liveweight is based on modelling liveweight change throughout the year, though that is not very precise. In this study, cow liveweight modelled over the year is extended to better account for the manner in which liveweight loss occurs between pre-calving and mating.

BACKGROUND

Breeding objective traits and values. The breeding objective in BreedObject includes cow weaning rate, cow survival rate, cow liveweight, cow condition score, calving ease (direct and maternal), weaning liveweight (direct and maternal), feedlot entry liveweight, finished sale liveweight, residual feed intake (pasture and feedlot), fat depth, dressing %, carcase meat % and carcase marbling score. Feedlot traits are included when there is a feedlot phase. Cow traits are for an average cow of the herd, with cow liveweight defined at mating (i.e. bull-in). Economic values of a trait are calculated at constant levels of all other breeding objective traits. Included in the economic value of cow liveweight is the cost of the increased feed required for maintenance and liveweight change of the cow. Procedures for assessing feed requirement are given by Freer *et al.* (2007). An increase in cow liveweight also affects returns, as these are greater when surplus cows are heavier.

Breeder description of the production system. Deriving breeding objectives and indexes with BreedObject relies on a breeder description of the production system, where the description is in terms of readily understood variables. Two types of annual feed period affecting cows are recognised: one when feed requirement cannot be increased without there being a cost (i.e. a 'limited pasture' period), and a period (often short) when there would usually be surplus pasture.

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METHODS

Cow liveweight data. Records were available from an autumn-calving (Struan) Angus herd in southern Australia (Pitchford *et al.* 2015), and from spring-calving Tropical Composite (Belmont-TC, Brian Pastures and Toorak-TC) and Brahman (Swans Lagoon, Belmont-B and Toorak-B) herds in northern Australia (Barwick *et al.* 2009; Wolcott *et al.* 2014). Struan data were available for only 3 parities. Cows in the Struan herd were born in 2 consecutive years and cows in the northern herds were born in 4 consecutive years. Cows in a herd represented 26 to 113 sires. Liveweights in each herd were recorded every 2 to 3 months, including 54 to 60 days pre-calving. Figure 1 shows average weights of cows, in relation to calving and mating, relative to cow age. For convenience, only 4 of the 7 herds are illustrated. Average weight loss between pre-calving (prior to the first calving opportunity) and re-mating (46 to 59 days after calving) in the Struan, Belmont-TC, Brian Pastures, Toorak-TC, Swans Lagoon, Belmont-B and Toorak-B herds was 70.0, 50.8, 66.5, 88.8, 50.1, 54.8 and 67.4 kg, respectively. Corresponding average pre-calving weights were 545.8, 470.6, 454.1, 484.0, 417.2, 450.0 and 464.7 kg.

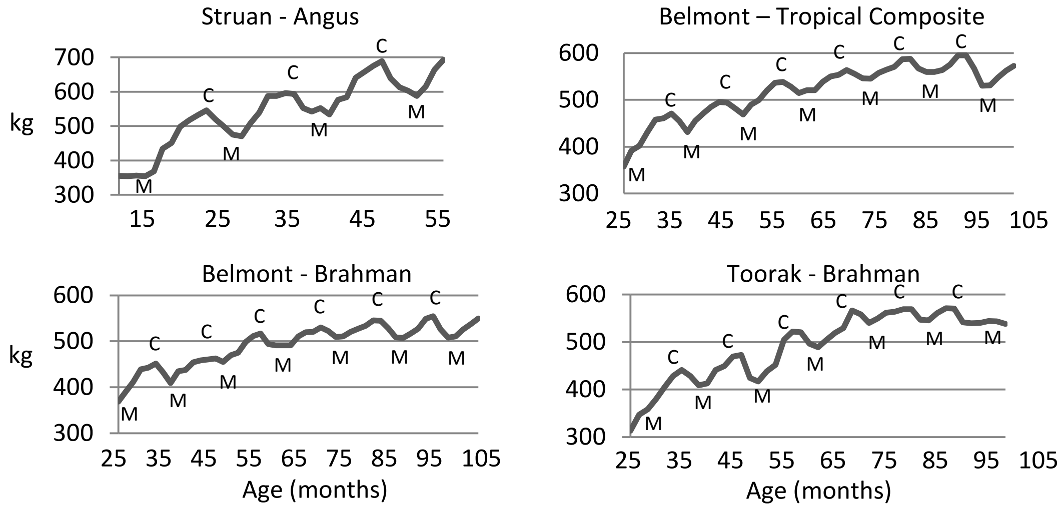

Figure 1. Average cow liveweights (kg), by cow age, for four herds. Also shown are the approximate occurrences of annual calvings (C) and matings (M).

Annual pattern of cow liveweight change. The annual pattern of cow liveweight change can be approximated from the breeder's description of the production system. The illustration in Figure 2 is for an example northern Australian system where the annual dry season is the period of limited feed and the wet season is the period of surplus feed. The system descriptors enabling the pattern to be derived are the timetable of management events, the average liveweight of cows at mating, the average liveweight loss occurring between pre-calving and mating, the length of any time interval pre-mating where the liveweight loss from pre-calving is maximum (shown as 'b' in Figure 2), the length of any period immediately pre-calving where cow liveweight is not increasing (shown as 'a' in Figure 2), and the relative rates of liveweight change between mating and weaning, post-weaning in surplus pasture, and in the early stages of the limited feed period.

Statistical analyses. The liveweight change in cows from pre-calving to re-mating, and mating liveweight, were analysed for each dataset to examine the effect of the regression on pre-calving liveweight. The records included were those from all cows present at the first calving opportunity.

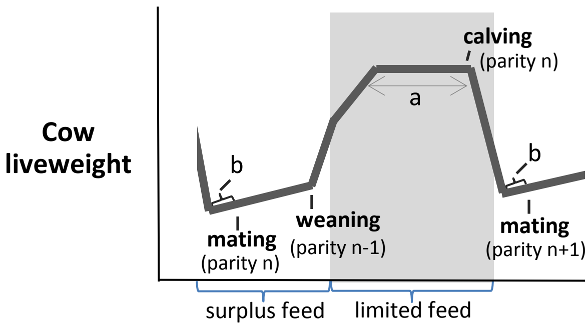

Figure 2. The derived annual pattern of cow liveweight change for an average cow, for an example northern Australian production system (schematic)

SAS Proc Mixed and the R lme procedures were used. The statistical model in each case also included effects that were significant in earlier analyses of the original experiments (Barwick *et al.* 2009; Wolcott *et al.* 2014; Laurence *et al.* 2015). These fixed effects included, for Struan: dam age, year, genotype (Fat vs RFI), genotype x year, High-Fat vs Low-Fat cows within genotype, management group (mg), and age at mating as a covariate nested within genotype (Laurence *et al.* 2015); for Tropical Composite (Brian Pastures, Belmont-TC and Toorak-TC): herd of origin (orig), mg, mg x orig, calf birth month (cbm) x orig (Wolcott *et al.* 2014); and for Brahman (Belmont-B, Toorak-B, Swans Lagoon): mg, cbm, calf sex, cbm x mg (Wolcott *et al.* 2014). For Struan data, replicate within year and herd of origin were fitted as random effects. Sire was included as a random effect in all analyses.

RESULTS

The regression coefficients in Table 1 show cow liveweight loss from pre-calving to mating, and mating liveweight, depend on the cow's liveweight pre-calving. Cows that differed by 100 kg pre-calving were estimated to differ by 8 to 32 kg in their weight loss, on average, across herds and breeds, and by 68 to 92 kg in their mating weight. Differences in cow liveweight, defined at mating, are thus associated with larger liveweight differences at the preceding calving.

Table 1. Regression coefficients (b) for regressions of cow liveweight loss from pre-calving to mating[1], and mating liveweight, on pre-calving cow liveweight in seven herds

Herd and breed	Liveweight loss (kg) from pre-calving to mating			Mating liveweight (kg)		
	b	S.E.	Prob	b	S.E.	Prob
Struan – Angus	0.32	0.06	<.0001	0.68	0.06	<.0001
Belmont - Trop.Comp.	0.20	0.03	<.0001	0.81	0.03	<.0001
Brian Pastures - Trop. Comp.	0.18	0.02	<.0001	0.81	0.03	<.0001
Toorak – Trop. Comp.	0.24	0.04	<.0001	0.77	0.04	<.0001
Swans Lagoon - Brahman	0.08	0.04	0.0724	0.92	0.04	<.0001
Belmont - Brahman	0.19	0.03	<.0001	0.81	0.03	<.0001
Toorak - Brahman	0.13	0.06	0.0316	0.87	0.06	<.0001

[1]Liveweight loss between a cow's first calving opportunity and the subsequent mating

The cow liveweight curve that applies after a change in cow liveweight at mating (ie. at parity n+1) (Figure 3) is able to be approximated using the same variables. The relationship that is used between cow liveweight loss from pre-calving to mating and pre-calving liveweight is taken from the breeder description and thus is specific to the production system described.

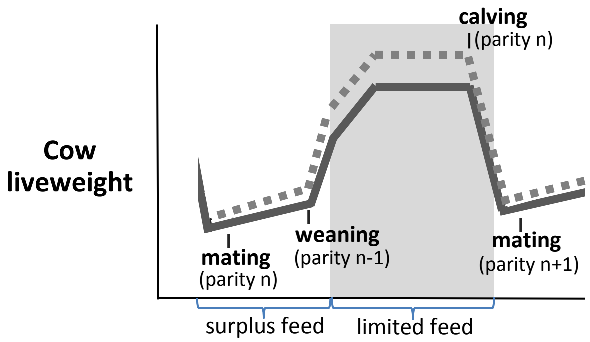

Figure 3. The derived annual pattern of cow liveweight change, before (▬) and after (▪▪▪) change in cow weight, for an example northern Australian production system (schematic)

DISCUSSION AND CONCLUSIONS

Figure 1 illustrates the systematic annual pattern of cow liveweight change that occurs in many herds and breeds. It supports the description given by Cole (1970). The annual pattern for an average cow, before and after change in cow liveweight, can be approximated from breeder-described variables for any production system (Figures 2 and 3).

Table 1 shows cow liveweight loss from pre-calving to mating, and cow weight at mating, change in proportion to the liveweight of the cow pre-calving. A change in cow liveweight at mating is consequently associated with a greater change in cow liveweight pre-calving (Figure 3). This affects the value of cow liveweight in the breeding objective, as the greater requirement pre-calving usually affects feed costs. It is the difference in feed requirement over all periods of the year when feed has a cost, before and after trait change, that determines the feed cost associated with the change.

The described procedure has been incorporated in BreedObject and will improve the precision with which cow liveweight is linked to feed cost in deriving individual breeding objectives.

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