SELECTION FOR CALVING EASE JOINTLY WITH OTHER PROFIT TRAITS IN BEEF CATTLE

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SUMMARY
Methods used to value calving ease in the customisable breeding objectives and selection index system 'BreedObject' (Barwick and Henzell 1998) are briefly described, including a procedure for achieving appropriate non-linear selection emphasis on calving ease EBVs (estimated breeding values). Calving ease direct (CEd) and maternal (CEm) traits were potentially as important to the breeding objective studied as were sale liveweight and cow weight combined. The importance of calving ease was sensitive to levels assumed for expected calving difficulty and their associated costs, especially for CEd. Marked changes in correlations between the rankings of sires on index and rankings on calving ease EBV and birth weight EBV demonstrated that the methods used are very responsive to the differing calving ease circumstances that can be encountered in industry.
Keywords: Beef cattle, selection, calving ease, non-linear, correlation.

INTRODUCTION
A long-standing issue in beef breeding is how much to value calving ease, given the greater risk of calving difficulty that can be associated with increases in other traits, such as growth. Dekkers (1994) examined breeding strategies for calving ease in dairy cattle, and Amer *et al.* (2001) considered calving ease in breeding objectives for beef cattle in Ireland. Non-linear issues can be important in breeding for calving ease. The present study briefly describes methods used to value calving ease in the customisable breeding objectives and selection index system 'BreedObject'. It includes a procedure for achieving appropriate non-linear selection emphasis on calving ease EBVs. Ramifications of different levels of expected calving difficulty, and their associated costs, are illustrated for aspects of the breeding objective and for selection rankings in industry data.

METHODS
Breeding objective and trait definition. A breeding objective was derived, using BreedObject, for production of 420kg liveweight steers at 17months from a self-replacing herd at pasture. Breeding objective traits were CEd and CEm (%), sale liveweight direct (SWd) and maternal (kg), carcase dressing %, carcase saleable meat %, and carcase P8 fat depth (mm); and cow liveweight (CW) (kg), cow weaning rate (%) and cow survival rate (%). Calving ease on the incidence (%) scale was binomial (assisted/unassisted) and assumed to reflect an underlying, normally distributed liability variable. Heritabilities were 0.10 for CEd and CEm on the underlying scale (Koots *et al.* 1994).

Calving ease trait economic values. Trait economic values (EVs) were defined as the marginal profit change for a unit of trait improvement, and trait relative EVs (REVs) as $EV.\sigma_g$. REVs measure

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trait importance to the breeding objective. EVs for CEd and CEm were calculated in present $(A) per % change in herd mean calving ease, and expressed per cow joined in the herd per year. Discounting used was similar to that of McArthur and del Bosque Gonzalez (1990). For CEd when replacement heifers are kept, the EV comprises savings from the reduced probability of an assisted calving in current herd heifers (α) and cows (β), and genetic flow-on effects in improved heifers (χ) and cows (ϕ). For CEd in terminal sires, only the reduced probabilities in current herd heifers and cows apply. For CEm, savings come only from components χ and ϕ, though the improvement in a daughter is fully expressed in the daughter's calving. Costs for an assisted calving include labour and veterinary costs, assumed constant for all calving events, and expected performance losses in calf survival, cow survival and cow re-breeding. The chances of these associated losses differ for heifers and cows, and underlie assumed herd mean rates for these traits, which do not change.

Including calving ease in selection. BREEDPLAN calculates multiple-trait calving ease genetic evaluations on the underlying liability scale (Hoeschele *et al.* 1995). These are interpreted at relevant thresholds and are presented to industry as estimated breeding values (EBVs) for % unassisted calving. In BreedObject, calving ease is valued on the incidence (%) scale. BREEDPLAN underlying-scale evaluations are re-interpreted at appropriate thresholds from one modelled situation to another, with the result that the calving ease (%) EBVs themselves change. Non-linear mapping between the liability and incidence scales produces more spread in the EBVs as the mean level of assistance increases (to 50%). The varying spread in the EBVs contributes to achieving appropriately changed selection emphasis for calving ease when selection is across a range of EBVs.

BREEDPLAN EBVs for differing aspects of performance are the selection criteria included in selection indexes in BreedObject. Methodology is given by Schneeberger *et al.* (1992). Calving ease is included by valuing, directly for each of CEd and CEm, the change in % calving ease in progeny that is expected to be associated with each animal's calving ease EBV. Checks are performed that the level of expected change is not greater than the herd mean level of assistance in each of heifers and cows. The assessed calving ease impacts are multiplied by 2 to maintain aggregate breeding value as the selection index unit. These total impacts for each animal are then added to the index of all other EBVs.

Analyses. The levels of calving assistance and associated costs shown in Table 1 were examined for their influence on REVs for CEd and CEm, and on selection rankings in industry data. The levels represent a possible industry range. Calving ease REVs were compared against those for SWd and SWd + CW. The REV of the latter sum represents the combined importance of breeding for greater growth; in this study the REV for SWd + CW is smaller than that for SWd because of a negative EV for CW.

Selection indexes for the breeding objective were derived for each level of the variables in Table 1. In addition to valuing calving ease impacts, these indexes included the following EBVs (genetic correlations assumed with CEd, CEm are shown in parentheses): birth weight (direct)(-0.40, 0.15), 200d weight (maternal) (0, -0.10), 600d weight (-0.17, 0), mature cow weight (-0.23, 0), days to calving (-0.07, -0.20), P8 fat depth (0, 0), retail beef yield percentage (0, 0). The genetic correlation of CEd with CEm was –0.50. Each index was applied to data on 1037 published sires of the Angus breed and differences in rankings on each index were assessed with rank correlations. Differences

Table 1. Levels examined for variables contributing to calving ease economic values[1]. Where a distinction is made, values for heifer calvings are shown first, with values for cows in parentheses. Level 3 is the base level otherwise assumed

Variable	Level 1	Level2	Level 3	Level4	Level 5
Herd calving assistance level (AL)(%)	0 (0)	15 (3)	30 (5)	45 (8)	60 (10)
Chance of calf death (ACD)(%)[2]	0 (0)	13 (5)	25 (10)	38 (15)	50 (20)
Chance of breeding cow death (ABD)(%)[2]	0 (0)	8 (3)	15 (5)	23 (8)	30 (10)
Chance of cow not re-breeding (ANB))(%)[2]	0	13	25	38	50
Chance veterinary assistance needed (V)(%)	0	3	5	8	10
Labour (non-vet.) cost (L) ($)[2]	0	30	60	90	120

[1]The contribution of AL is to the REV by influencing σ_g. Levels 1 to 5 represent herd mean calving assistance levels of 0, 5.2, 9.6, 14.8 and 19.1 percent, respectively
[2]Per calving, given that it is assisted

in the ranking of sires on index compared with their rankings on calving ease or birth weight EBVs (components of the index) were also examined with rank correlations.

RESULTS AND DISCUSSION
Although there are differences, for example in the discounting used, the described method of valuing calving ease traits in the breeding objective appears similar in most important respects to that of Dekkers (1994) and Amer *et al.* (2001). Improvement mediated through calves, ie., from joinings of improved bulls with current herd cows, accounted for 60% of the EV for CEd in the base case. Dekkers (1994) found this to be the largest component of the EV for CEd in dairy cattle.

Figure 1 shows calving ease can be very important to the breeding objective, base level REVs being as large or larger than those of sale liveweight and cow weight jointly (SWd + CW) for both CEd and CEm. The slopes of curves in Figure 1 are a measure of the sensitivity of the assessed importance of breeding for calving ease to change in particular variables. Results were especially sensitive to changes to all variables in combination (ALL), particularly for CEd. The combinations in ALL may involve greater changes than would usually be encountered. The sensitivity of the REV to the changes nonetheless suggests a need for reliable information on assistance levels and associated costs for bulls of known calving ease EBV level (eg. breed average) in a range of breeds and herds.

Sire rankings on index for level 5 variables (representing most assistance needed) were lowly correlated (0.34) with index rankings for level 1 variables (no assistance). Index rankings for the base case were correlated 0.86, 0.93, 1.00, 0.91 and 0.76 with index rankings for levels 1 to 5, respectively. While the levels of assistance and costs considered are larger and cover a greater range than would usually be encountered in Angus, the results illustrate trends and provide an estimate of upper limits to ranking differences within a breed for the breeding objective studied.

The correlations between rankings of sires on index and their rankings on EBVs for CEd and CEm were respectively -0.35, -0.23, 0.07, 0.42 and 0.61, and 0.12, 0.17, 0.26, 0.30 and 0.29, for level 1 to 5 variables. Index rankings were increasingly positively correlated with CEd EBV as the expected level of calving assistance needed increased. The correlations between sire rankings on index and

a) Calving ease (direct)   b) Calving ease (maternal)
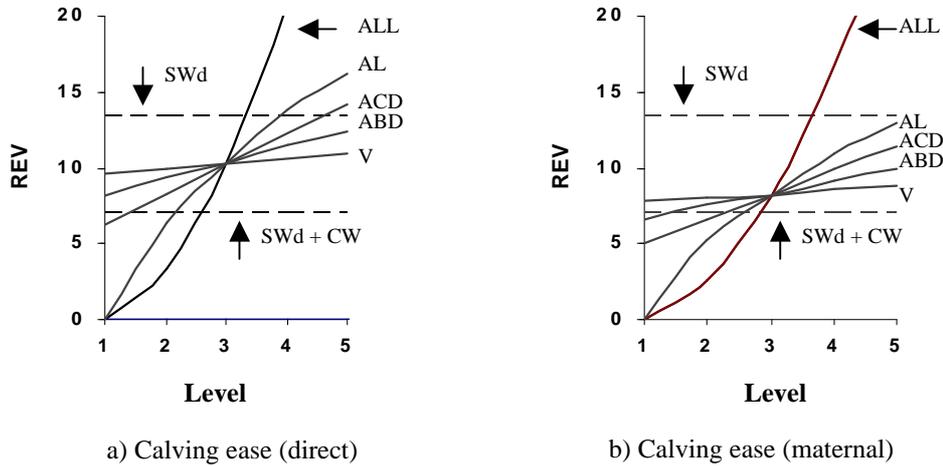
Figure 1. Effect of variable level on calving ease trait REVs for a Domestic market breeding objective. REVs for sale weight direct (SWd) and for SWd plus cow weight (SWd + CW) are shown for comparison. Changes are to individual variables, at other base values, as well as to all (ALL) variables. Results for ANB and L fall between those for V and ABD, and ABD and ACD, respectively. See Table 1 for abbreviation details.

their ranking on birth weight (direct) EBV correspondingly decreased as the level of calving assistance needed increased. These correlations were 0.54, 0.47, 0.25, -0.04 and –0.23, respectively, for level 1 to 5 variables. These results demonstrate the responsiveness of the methods used to the changing calving ease circumstances that can be encountered in industry.

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